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Three Essays on CEO Risk Preferences, and Ability, Corporate Hedging Decisions, and Investor Sentiment

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THREE ESSAYS ON CEO RISK PREFERENCES, AND ABILITY, CORPORATE HEDGING DECISIONS, AND FIRM VALUE

by

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ABSTRACT

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The derivative hedging research has looked at why firms and how firms hedge and if it increases value for their shareholders. In this dissertation we investigate the relation between CEO risk preferences and ability and whether if affects their hedging decisions and firm value.

In our first essay, we challenge the theory and previous empirical evidence that showed CEO risk preferences affects hedging. Using a sample of Fortune 500 firms and 5 years of panel data, and using inside debt (i.e., CEO pension and deferred compensation) and the CEO Vega and CEO Delta, as proxies of CEO risk preferences, we document that neither risk-averse (i.e., debt like compensation) nor risk-seeking (i.e., convex compensation) inducing CEO compensation packages influence corporate hedging. Moreover, we find CEOs who have more previous work experience and high job tenure to be positively related to hedging.

Essay 2 examines the hedging intensity and market value sensitivity of firms run by CEOs with different risk preferences. We find derivatives hedging intensities of risk-seeking and risk-averse CEOs to be fairly similar, suggesting that compensation contracts designed to motivate risk-seeking (less hedging) behavior do not succeed to alter CEOs' inherent risk-aversion. We also find, that if the underline asset prices change by three standard deviations the average firm's derivatives portfolio creates only modest gains for both types of CEOs. These results seem consistent with the view that hedging is just an insurance policy and not a firm value

increasing strategy.

In Essay 3, we investigate whether high-ability managers are more likely to engage in hedging to reduce the level of information asymmetry with the aim of protecting their reputation capital in a competitive executive labor market, as predicted by the theory of managerial responses to asymmetric information. We find that high-ability managers do not engage in greater hedging than their low-ability counterparts as the theory of managerial responses to asymmetric information predicts. Specifically, the results show that high-ability managers significantly increase firm value, but they do not undertake more hedging than low-ability managers who fail to increase firm value. Our findings suggest that high-ability managers safeguard their reputation capital through effective implementation of value increasing strategies than through hedging implying that they view hedging as an insurance policy against exogenous uncertainties.

Overall, this dissertation investigates how CEO risk preferences and ability, affects their hedging decisions and if they increase firm value. Given the widespread use of derivatives for risk management purposes, the findings of this dissertation that hedging is not the main risk management strategy by CEOs (only 10-11% of total assets) and similar hedging intensities of risk seeking and risk averse CEOs questions the validity of the convex compensation contracts designed to make CEOs take more risk and suggests that hedging is more of an insurance policy rather than a value maximizing strategy.

I dedicate my dissertation work to my family and many of my friends, especially Sari Sami Alraddadi, Manoj Chandra and Sounak Kishore Saha for helping me financially and mentally during my stay at Old Dominion University. I also dedicate this dissertation to the help of many faculty and staff in Strome College of business, especially Dr. Vijay Kalburgi and Katrina Davenport. I will always appreciate all my classmates, Charles Swartz, Jiancheng Chen, and Rajib Chowdhury, for being with me throughout the entire doctorate program

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INTRODUCTION

This dissertation is to examine how CEO risk preferences and CEO managerial ability affect corporate hedging decisions and their relation to firm value. The widespread use of derivatives as a risk management tool to hedge interest rate risk, foreign exchange risk and commodity price risk motivates this study to see if derivatives hedging matters to firms or it is used just as an insurance policy. Using a sample of Fortune 500 non-financial firms and 5 years of panel data, we investigate this relationship in our three essays.

In our first essay, we challenge the theory and previous empirical evidence that showed CEO risk preferences affects hedging. Using a sample of Fortune 500 firms and 5 years of panel data, and using inside debt (i.e., CEO pension and deferred compensation) and the CEO Vega and CEO Delta, as proxies of CEO risk preferences, we document that neither risk-averse (i.e., debt like compensation) nor risk-seeking (i.e., convex compensation) inducing CEO compensation packages influence corporate hedging. Moreover, we find CEOs who have more previous work experience and high job tenure to be positively related to hedging.

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In Essay 3, we investigate whether high-ability managers are more likely to engage in hedging to reduce the level of information asymmetry with the aim of protecting their reputation capital in a competitive executive labor market, as predicted by the theory of managerial responses to asymmetric information. We find that high-ability managers do not engage in greater hedging than their low-ability counterparts as the theory of managerial responses to asymmetric information predicts. Specifically, the results show that high-ability managers significantly increase firm value, but they do not undertake more hedging than low-ability managers who fail to increase firm value. Our findings suggest that high-ability managers safeguard their reputation capital through effective implementation of value increasing strategies than through hedging implying that they view hedging as an insurance policy against exogenous uncertainties.

CHAPTER 1

CEO RISK PREFERENCES AND CORPORATE HEDGING DECISIONS: A MULTIYEAR ANALYSIS

ABSTRACT

Theory and previous empirical studies suggest that CEO risk preferences affect hedging. We challenge this idea in a 5-year time series setting by using inside debt (i.e., CEO pension and deferred compensation) and the CEO Vega and CEO Delta, as proxies of CEO risk preferences, and document that neither risk-averse (i.e., debt like compensation) nor risk-seeking (i.e., convex compensation) inducing CEO compensation packages influence corporate hedging. Moreover, we find CEOs who have more previous work experience and high job tenure to be positively related to hedging.

INTRODUCTION

Theory suggests that the extent of corporate hedging by managers depends upon the risk preferences of the CEO. Risk seeking CEOs take more risk due to the higher payoff of convex compensation contracts (CEO options) while risk-averse managers are more likely to act conservatively due to the linear payoff of the equity-like (i.e., CEO equity share compensation, CEO inside debt and CEO cash compensation) compensation contracts (Knopf et al. 2002; Smith and Stulz, 1985, Tufano, 1996). On the other hand, Smith and Stulz (1985), argue that derivatives usage is motivated by growth opportunities, reduction in expected taxes or for reducing the probability of financial distress. Despite the large literature on hedging, previous empirical evidence on these hedging explanations has been mixed.[1]

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[1] Campbell and Kracaw (1987), Bessembinder (1991), Dolde (1995), Mian (1996) and Haushalter (2000) find support for the reduction in distress costs argument; Froot et al. (1993), Nance et al. (1993), Mian (1996) and Graham and Smith (1999) obtain results in support of the reduction in expected taxes view while Froot et al. (1993), Haushalter (2000), Allayannis and Ofek (2001), and Geczy (1997) report evidence in support of the reduction in underinvestment costs. On

The inconsistency in the empirical literature about the forces behind corporate hedging could be attributed to several reasons that motivate this study. First, most of the previous studies on the relation between derivatives hedging and managerial compensation, controlling for firm characteristics, perform cross-sectional analyses relying on just one year of data (Knopf et al. 2002; Tufano, 1996). Using a hand collected unique dataset that spans a 5-year period from 2008-2012 period, a comprehensive investigation is conducted on the relation between hedging and managerial risk preferences. This approach permits to draw inferences about the role of managerial risk preferences and hedging over a five-year period rather than relying on 1 year of data. Second, unlike previous studies that have mainly focused on currency hedging, in this paper both currency and non-currency (interest rate and commodity) corporate hedging activities are analyzed since non-FX derivatives constitute more than 50% (see Table 2) of total derivatives used by our sampled firms. Focusing on all derivatives used (foreign exchange, interest rate and commodity) permits to overcome the selection bias likely to be present in studies that focus exclusively on a subset of derivatives used by corporations. Moreover, the exclusion of a subset can influence the statistical significance of the empirical tests or produce distorted results. Third, different from most previous studies that attribute hedging to a number of different factors, in this study, besides the role of managerial risk preferences, managerial past experiences and education are examined as potential influences on corporate hedging decisions.[2]

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the other hand, Tufano (1996) does not find that hedging is associated with any of the above-mentioned reasons except for the managerial risk aversion while Sprcic and Sevic (2012) find empirical evidence only in support of the reduction in underinvestment costs motive. Knopf et al. (2002) fail to find a relation between delta and hedging, but report a stronger relation between vega and hedging, significant only at 10%. This relatively weak evidence seems to suggest that convex CEO compensation motivates risk-taking at the expense of hedging. Geczy et al. (1997) and Haushalter (2000), however, find no relation between CEO option holdings and hedging, implying that the relationship between options related compensation and hedging is inconclusive.

[1] Beber and Fabbri (2012) is the only study that looks at the role of managerial past experiences and education affects hedging, but focuses only on currency hedging.

[2] Beber and Fabbri (2012) is the only study that looks at the role of managerial past experiences and education affects hedging, but focuses only on currency hedging.

One of the main contributions of this paper is that it examines whether CEO characteristics (i.e., risk preferences, education, age, past experiences, and sex) affect hedging decisions after controlling for managerial compensation and firm level characteristics. Since it is the CEO who makes the final decision to hedge or not to hedge, his personal characteristics and past experiences/education may exert considerable influence on corporate hedging. The "Upper Echelon theory" of Hambrick and Mason (1984), which states that firm outcomes can be partially predicted by managerial characteristics, past experiences and values, supports this notion. To the best of our knowledge, only Beber and Fabbri (2012) have examined the role of CEO characteristics on hedging but they focused only on firm's currency derivatives. However, when they address the role of managerial past experiences and education in the context of corporate currency hedging they concentrate on derivatives which are used for speculation rather than hedging. Since firms disclose derivatives that are used for speculation and hedging separately, in this paper derivatives marked as "hedging" are used to determine if CEO characteristics affect firms' hedging decision.

Another interesting feature of this study is that it draws inferences about the relation between managerial compensation and hedging relying on a panel level regression analysis. Most of the previous studies have looked at cross-sectional data, and this could be the reason for the mixed evidence regarding the motives of hedging as mentioned earlier.

Using a hand collected unique dataset over the 2008-2012 period, the evidence yields the following results. First, we find that CEO risk-preferences, based on Delta and Vega metrics, have no significant bearing on hedging decisions in our baseline regression and alternative regression specifications and the results hold even after controlling for endogeneity. This casts considerable doubt on the view that managerial risk sensitivity measures (Vega and Delta) influence corporate hedging decisions. Similarly, none of the other CEO risk preference measures (i.e., cash compensation, CEO firm equity and inside debt) are significant.

Second, using firm level control variables to test the validity of the three theories of Smith & Stulz (1985), we find no support for any of these theories even after addressing endogeneity concerns. We find firm size (Assets) to be negatively related to hedging consistent with the results obtained by Warner (1977) and O'Brien & Bhushan (1990). We also find the foreign sales and idiosyncratic firm risk to be positively related to hedging.

Moreover, examining the role of CEO characteristics, including their past experiences and education, we find CEO job-tenure to be statistically significant and positively associated with hedging suggesting that CEOs with longer tenure are more likely to be risk averse and as a result hedge more. This result holds even after we control for endogeneity. Next, we examine the effect of the number of companies a CEO worked before joining the current company, and find that it has a positive and significant impact on hedging contradicting the evidence of Beber and Fabbri (2012) who report a negative effect on hedging, but mildly significant. The significance and positive sign of this variable suggests that CEOs with greater work experience tend to favor hedging. This result holds even after controlling for endogeneity.

Finally, CEO education and past work experience do not appear to be significantly associated with hedging as none of the education and experience variables (i.e., MBA, previous financial, technical education, Finance and technical experience) are significant.

One problem in examining the relation between managerial compensation and hedging is endogeneity bias. CEOs self-select firms with specific firm characteristics like larger firm size, larger R&D expenses, and lower firm risk resulting in endogeneity. To address the problem of endogeneity, we use the Shen and Zhang (2013) method. First, we regress the CEO compensation variables (i.e., CEO cash compensation, CEO Delta and Vega, CEO inside debt, and CEO share equity) against the firm characteristics mentioned in Shen and Zhang (2013). Then, we use the excess compensation values (residuals) from the previous step as the independent variables and replicate the fixed effect regression. This partially solves the endogeneity problem mentioned earlier and thus we can control for the likely contamination effect of the CEO compensation determinants on our main risk preference variables. Using the excess compensation variables, the risk preference variables are insignificant in all of the models. The signs and significance of firm variables and CEO characteristics variables are similar as the previous regression results. None of the CEO education variables are significant.

The remainder of the paper is organized as follows. In section 2, we provide the related literature review of factors affecting hedging leading to the hypothesis development. Section 3 explains the data and methodology. Section 4 presents and discusses the results. Section 5, provides avenues for future research. Section 6 concludes.

LITERATURE REVIEW AND HYPOTHESIS DEVELOPMENT

CEO incentives and risk taking

Jensen and Meckling (1976) show that agency costs arise due to the owners and managers' trying to maximize their own interests resulting in conflicts of interest between them. To reduce agency costs, owners devise compensation contracts to align the conflicting interests of managers and shareholders. Managers are usually risk averse since they are invested both personally and monetarily in the firm they manage and so their policy decisions are normally conservative compared to a well-diversified shareholder. Option based compensation contracts are one-way shareholders (owners) use to incentivize managers take more risk owing to their convex payoff structure (Smith and Stulz, 1985; Tufano, 1996; Rajgopal and Shevlin, 2002; Hemmer et al. 2010). Guay (1999) documents that stock options add convexity to managers' portfolios which, in turn, mitigate managerial risk aversion. That is, encourage risk-taking decisions Delta and Vega are two measures that have been used extensively to proxy for CEO's risk sensitivities. Vega measures an option's sensitivity to changes in the volatility of the underlying asset while Delta measures the price change of an option to the change in price of the underlying asset.[3] Both measures have been used in previous studies to gauge the influence of compensation packages on managerial corporate decisions, as they aim to incentivize risk-taking (Vega) and/or risk-aversion (Delta) (Knopf et al. 2002; Caliskan and Doukas, 2015). Since hedging is viewed as a conservative policy, CEO Vega is expected to be negatively associated with hedging (i.e., hedge less in line with shareholders' risk-seeking desire) due to the convex nature of this payoff, while Delta is predicted to be positively associated with hedging due to the CEOs high equity stake in the company which makes them risk averse and thus hedge more. However, previous empirical studies have failed to provide any concrete evidence in support of more (less) hedging when managers' compensation is loaded with concave (convex) contacts. Guay (1999), for example, shows that Vega of the option portfolio induces CEOs to take more risk while Knopf et al. (2002) find no relation between Vega and hedging. Coles et al. (2006) find higher Vega and lower Delta of CEO option portfolio to be associated with risky firm policy choices.

The Vega and Delta measure the sensitivity of the value of the CEO's accumulated equity-type compensation to a one percent change in the volatility of stock price, and to one-percent change in the stock price, respectively. Hence, CEO options create two contrasting effects on the risk attitude of CEOs (Lambert, Larcker and Verrecchia, 1991; Carpenter 2000; Knopf et al. 2002): (i) sensitivity to stock return volatility which motivates risk-taking behavior (less hedging) due to the convexity payoff structure of CEO compensation (i.e., stock options become valuable (in-the money) with less derivatives hedging) and (ii) sensitivity to stock price which motivates risk-averse behavior (more hedging) due to the linear association between the CEOs' stock options (wealth) to the stock price

[3] Vega represents the amount that an option contract's price changes in reaction to a 1% change in the volatility (σ) of the underlying asset. Delta is the first derivative of the value of the option with respect to the underlying instrument's price.

(i.e., stock options link a CEO's wealth to the stock price). Thus, higher Vega (Delta) means CEOs will take more (less) risk and hedge less (more) with derivatives.

In addition, CEO stock ownership is also expected to play a part in corporate hedging decisions. Specifically, CEOs with high stock ownership are expected to be less diversified and as a result be more conservative favoring greater hedging (Stulz, 1996). Similarly, CEOs with higher cash compensation (i.e., salary and bonus payments), are expected to be more risk averse and exhibit a stronger preference for hedging as a large fraction of their wealth would be attached to the firm performance (Knopf et al. 2002). The final CEO variable examined in our analysis is inside debt, debt like compensation contracts, which comprises of CEO pension and CEO deferred compensation. Jensen and Meckling (1976) and Edmans and Liu (2011) argue that debt like compensation increases CEO risk aversion leading to less risky decisions. Hence, we hypothesize that CEOs with greater inside debt holdings are expected to be less risk tolerant and thus be in favor of hedging.

Hedging and firm risk management

Firms use derivatives to hedge or speculate depending upon the industry they are in. Tufano (1996) finds that more option like compensation incentivizes managers to take more risk due to the convex payoff structure of the options. Non-financial firms use derivatives to hedge their interest rate (IR) risk, commodity price (COMD) risk and foreign currency (FX) risk. Allayannis and Ofek (2001) have shown that firms use currency derivatives to hedge currency exposure rather than to speculate. There are many reasons firms would want to hedge. Firms hedge to reduce the financial distress costs arising due to bankruptcy (Smith and Stulz, 1985; Graham and Rogers, 2002), to reduce the underinvestment costs associated with investment opportunities when external financing costs are high (Gay and Nam 1998; Geczy et al., 1997; Knopf et al. 2002; Froot et al., 1993) or to reduce the

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Delta is also known as the hedge ratio.

expected tax liability (Mayers and Smith, 1982; Nance et al. 1993; Graham and Rogers, 2002). Also, many firms hedge to reduce cash flow volatility and thus increase firm value (Allayannis and Weston, 2001; Carter et al. 2006; Mackay and Moeller, 2007). The evidence, however, on these hedging motives is mixed. Most of the previous literature has used cross-sectional data to test the above-mentioned hedging motives (Knopf et al. (2002); Rogers (2002) etc.). In this paper, all hedging motives arising from the work of Smith and Stulz (1985) (i.e., managerial risk aversion and efforts to reduce (i) expected taxes, (ii) distress costs, and (iii) underinvestment costs) are tested using a panel data set.

CEO personal characteristics and risk taking

The relationship between managerial characteristics and decision-making has been looked upon extensively in the management literature. The most popular theory in this context is the "Upper Echelon theory" created by Hambrick and Mason (1984), which states that firm outcomes can be partially predicted by managerial characteristics, past experiences and values. Weisbach (1995), Chevalier and Ellison (1999) and Bertrand and Schoar (2003) have shown that individual managers shape corporate decisions even after controlling for firm fixed effects and market level factors. There is a large body of literature that talks about past experiences and personal characteristics and how it affects managerial decision-making.

However, to this date, not much research focus has been directed in exploring how managerial characteristics and past experiences affect firms' hedging decisions. The psychology literature shows that personal experiences affect one's personal decision making (Hertwig et al. 2004; Weber et al. 1993, among others). Thakor (2010) also talks about the "experience based beliefs" where personal experiences that one encounters play a big part in decision-making. Kaustia and Knupfer (2008), Chiang et al. (2011) and Choi et al. (2009) among others show that personal experiences affect economic decisions. Even though hedging policies are taken by a group of individuals and not one individual, it is the CEO who is ultimately responsible for the signing off and enacting and reinforcing these policies. The overconfidence model of Gervais and Odean (2001) can be used to explain the role of CEO characteristics, like CEO age, CEO gender, and CEO education qualifications and work experience, on corporate hedging. One CEO characteristic that has been seen to affect risk-taking behavior is age, but the empirical evidence is mixed. Holmstrom (1999), Zwiebel (1995), Hirshleifer and Thakor (1992) among others find that younger CEOs are risk averse while Serfling (2014), Prendergast and Stole (1996), Hambrick and Mason (1984) among others, show that younger CEOs take more risk. Thus, the relation between CEO age and hedging could be positive or negative. In line with the CEO life cycle literature (Pan et al., 2016; Limbach, Schmid, and Scholz, 2016), it's also likely that an inverse U-shaped relationship could also emerge. CEO gender is another characteristic that may affect hedging decisions. Huang and Kisgen (2013), Barksy et al. (1997) and Prince (1993) among others report that women managers are risk averse (and so should hedge more) while Schubert et al. (1999) and Atkinson et al. (2003) fail to find any relation between risk aversion and gender. Thus, we hypothesize that male CEOs are more likely to hedge less compared to their female counterparts.

CEO tenure is another feature that might affect CEO hedging decisions. Chen (2010), Fu and Li (2010), and Hermalin (1993) among others show that tenure is associated with positive risk taking (and so should hedge less) while Bertrand and Mullainathan (2003), John et al. (2008), and Pathan (2009) among others find tenure to be negatively related to risk taking (and so should hedge more). Hence, the sign of the CEO tenure measure is expected to be positive or negative. Past experiences, also tend to affect CEO's decision-making process. Elder (1986), Elder et al. (1991) and Malmendier and Tate (2011) have shown that individuals who have served in the military are more aggressive and risk tolerant. Hence, we expect CEOs with military experience to be less conservative and as a result hedge less. Malmendier and Tate (2005) find that CEO financial education and past finance work experience make them overconfident and so tend to engage in risky investments. Thus, consistent with the prediction of the overconfidence model of Gervais and Odean (2001), we hypothesize that CEOs with greater education qualifications or financial/technical education would enhance CEO overconfidence leading to less hedging. Additionally, previous CEO financial experience or greater working experience in more firms before joining the current firm would raise the level of CEO overconfidence and thus we hypothesize less hedging and take more risk-taking (Beber and Fabbri, 2012)

DATA SOURCES AND METHODOLOGY

Data Collection

Data for the analysis are obtained from the Fortune 500 list. We chose the Fortune 500 list for our analysis for two reasons. First, most of the Fortune 500 companies are big and are more likely to use derivatives, compared to smaller firms as usage of derivatives is costly (Bodnar and Marston, 1998). Second, the Fortune 500 list encompasses companies from a wide array of industries, and so that would negate any industry bias. The initial sample consists of 500 companies out of which commercial banks, diversified financials, securities and insurance companies are omitted as their purpose of using derivative is completely different (mainly speculation) from non-financial firms (mainly hedging risk). That reduces the sample size to 434 companies. The gross notional derivative information is obtained from the Mergent online database which was used to pull out 10K's of all the 434 companies for 5 years, i.e. , from 2008 to 2012 for a total of 2170 firm-year observations. To search for derivatives, we used the terms "hedge", "notional", "swaps", "foreign currency", and "forwards". We use the notional amount of derivatives from the 10k's to account for the derivatives. Some of the previous literature has used fair value of derivatives as the dependent variable but using fair value has many problems. First, the total notional amount of derivatives is the aggregate number that the CEO has used for hedging which correctly depicts his risk taking ability and currently denotes the total price the hedge has been established. Since the market value (fair value) of derivatives changes with the economy, it is not a reliable source for evaluating firm's total financial risk. Second, very few firms report fair value in their 10ks and so using fair value would result in loss of many observations. On the other hand, all firms reveal their total notional amount of derivatives in their 10ks. Thus, firms which do not report notional value of their derivatives in their 10ks (only fair values mentioned) are removed. In addition, private companies are excluded because they do not have public accounting data. Consistent with Geczy et. al. (1997), firms involved in mergers and acquisitions (M&A) in the course of 5 years, are also removed from our sample. This reduced the sample to 350 firms with 1630 total firm-year observations.

The Thomson Reuters' database and Google finance are used as the main sources to obtain firm financial data. For managerial compensation data, only the CEO's compensation/past experiences/education data are used. Some previous papers have used COO/CFO data with the CEO data (Rogers, 2002). We use only the CEO's compensation/characteristics data for two reasons. First, and most importantly, even though financial hedging decisions are taken by a group of individuals, including the CFO, it is the CEO who ultimately approves/disapproves the hedging decision. Second, using managerial compensation data of other corporate officers along with the CEO's will produce a set of mixed hedging incentives because the hedging motives of other corporate officers differ from the hedging incentives of CEOs (Knopf et al. 2002). Finally, focusing on CEOs hedging incentives, captured through their compensation structure, allows to draw comparisons with previous studies.

CEO managerial compensation information is obtained from the ExecuComp database and proxy statements. Out of 350 companies, 10 companies did not have appropriate exercised and non-exercised options data in the ExecuComp database reducing the sample to 340 firms and a total of 1446 firm-year observations. Data for the CEO's past job qualifications/experience and education are obtained from the proxy statements, 10k's and the website www.nndb.com. We can't find appropriate experience information for 8 CEOs bringing the total sample to 332 firms with observations 1446 firm-year observations. The 332 firms of this study have made use of derivatives for commodity price fluctuations (commodity futures and swaps), interest rate risk (interest rate swaps and locks) and foreign currency risk (FX forwards and futures). In 10ks, firms report separately derivatives which are used for hedging and which are used for trading or speculation. We only include companies that use derivatives for hedging purposes and not for trading or speculation.

Also, for some companies using commodities, the10Ks had the notional amount of commodity hedged. For example, firm A had hedged 10mmBtu of natural gas and 45 million barrels of crude oil. In that case to find the derivatives amount, we multiply the total amount by the underlying price of the asset at that time. In addition, some companies had total number of contracts mentioned in their 10Ks; to get the notional amount we multiply the number of contracts by the total contract unit from the CME website and the underlying price at that time. In case of foreign currency forwards or futures, all values are converted to the dollar values using the exchange rate at that time of the initiation of the contract.

As far as we know, this is the first paper that looks at the relationship between managerial compensation and derivatives hedging over the course of a 5-year period. Also, CEO managerial characteristics/past experience variables have not been analyzed in the context of hedging. As mentioned above, only Beber and Fabbri (2012) have analyzed this relationship but they only looked at currency hedging. Finally, our data encompasses the financial crisis period, where CEO's decision making would be highly correlated with his past experiences and educational qualifications.

Fixed effect regression analysis is used to regress the log of the derivatives divided by assets of the firm on CEO compensation and personal characteristics, firm characteristics and CEO past experience and education.

Variables description

Dependent variable

The dependent variable in this study is the logarithm of the total notional value of firm's derivatives divided by the book value of its assets (*Log Derivatives/Assets*). Total derivatives consist of commodity derivatives (forwards and futures), interest rate derivatives (futures, forwards and swaps) and currency derivatives (futures, forwards and swaps). All the derivative data is hand-collected from the company's 10k filings for 5-year period, 2008-2012.

Independent variables

Managerial compensation variables:
Total CEO Delta of option and stock portfolio

CEO's options Delta is defined as the sensitivity of a CEO's option portfolio with respect to the stock price of the underlying security, also known as the "hedge ratio". In other words, Delta is the change in the option's Black-Scholes price in response to a 1% change in the share price. This measure has been used extensively in the previous literature as a proxy for risk aversion (Knopf et al. 2002, Rogers, 2002, Coles et al. 2006 among others). In the context of this study, the total Delta of a CEO's compensation portfolio (*Total CEO Delta*) is defined as the sum of the Delta due to the option portfolio and the stock portfolio. In accord with the main prediction of our hypothesis, we expect a positive relation between the CEO's option Delta and hedging since the payoff of the CEO option is directly related to the firm's stock price which is designed to encourage risk aversion.

CEO Vega of option portfolio

CEO's option Vega is defined as the sensitivity of a CEO's option portfolio with respect to the volatility of the stock price. In other words, Vega is the change in the price of the option portfolio in response to a 1% change in the stock volatility. This variable is used extensively in the previous literature as a proxy for CEO high risk tolerance (Knopf et al. 2002, Beber and Fabbri, 2012). The CEO's stock Vega is not significant as volatility of stock is close to zero (Guay, 1999). Thus, the total Vega of the CEO option portfolio (Total *CEO Vega*) is only due to the volatility of the option portfolio. Hence, we expect a negative relation between Vega and derivative holdings (hedging) due to the convex payoff of the option-like contracts.

Calculation of total Vega and total Delta of option and stock portfolios

The Delta and Vega of the stock option portfolios are calculated using the Core and Guay (2002) approach. Core and Guay (2002) separately calculated the option grants for the current year and the previously granted options. For the current year option grants, we collect data for CEOs' number of options from the ExecuComp database. Exercise price and time of maturity variables for current year option grants are obtained from ExecuComp. Other variables which are required to estimate the Delta and Vega like stock price, volatility, interest rate and dividend yield are collected from the firm proxy statements and 10k reports. Consistent with the previous literature, the Black-Scholes option valuation formula is used to calculate the option price for the current-year options

(Knopf et al. 2002; Rogers, 2002).

For the previously granted options, ExecuComp lists separately the number of exercisable and un-exercisable options in their database but it does not contain the exercise price and time of maturity variables for them. The Core and Guay (2002) approach is used to approximate the time of maturity and exercise price for both exercisable and un-exercisable options. We calculate the Delta and Vega of the exercisable and un-exercisable options separately. Time of maturity of the previously exercisable options, is approximated as the time of maturity of current options minus four, and for previously un-exercisable options, time of maturity minus one. We calculate the exercise prices by subtracting the total value of the option portfolio and the current year option portfolio value. Then, we divide this number by the number of options to get the difference of the stock and exercise price. Finally, we subtract this number with the stock price to get the exercise price. We calculate the exercise price separately for exercisable as well as un-exercisable options. Core and Guay (2002) have shown that this approximation is very close to actual values. Other variables which are required to estimate the Delta and Vega of previously granted options like stock price, volatility, interest rate and dividend yield are collected from the firm proxy statements and 10k reports. Appendix B provides the calculation of Delta and Vega using the Black-Scholes Options model.

We also calculate the Delta of the stock portfolio of the CEO. Thus, the total Delta of the option portfolio is the sum of the Delta of the current year option portfolio, plus Delta of previous year's exercisable and un-exercisable options and the sum of the Delta of the stock portfolio. Similar calculation procedure is employed to estimate the Vega of the current option grants, previous exercisable and un-exercisable options. Vega for the stock portfolio is assumed to be zero. Therefore, the total Vega is the sum of the Vega of the current year options, previous year's exercisable and previous year's un-exercisable options. Finally, we multiply the Vega and Delta with the total number of options to obtain the Vega (*CEO Total Vega*) and Delta (*CEO Total Delta*) of the entire CEO compensation portfolio. The above-mentioned procedure is used to calculate the Vega and Delta for each of the five years (2008-2012).

CEO firm stock holdings

This variable captures the total CEO stock holdings (*CEO Share Equity*) in the firm. CEOs' with high stockholdings in the firm they run, are more likely to exhibit low risk tolerance, since a large fraction of their personal wealth would be invested in the firm (Stulz, 1984), and as a result engage in more hedging. Thus, we expect the CEO stock-holdings variable to have a positive effect on hedging. Data for CEO stock holdings are collected from ExecuComp database for all the 5 years.

CEO inside debt and CEO cash compensation

Sundaram and Yermack (2007) and Edmans and Liu (2011) suggest that CEOs with higher inside debt (*CEO Inside debt*) are more likely to exhibit low risk tolerance since a large fraction of their wealth is tied to company stock performance and job security. Consequently, if inside debt deters CEO risk taking, we expect to observe a positive relation between hedging and CEO inside debt. The CEO inside debt variable is the combined value of deferred compensation and pension of the CEO. Similar with the influence of CEO inside debt holdings on hedging, CEO cash compensation (*CEO Cash Comp*) is expected to have a positive effect on hedging (i.e., incentivize CEOs to hedge more) because of the linear nature of cash compensation.

Firm level control variables

Shareholder maximization theory provides three reasons of hedging (Smith and Stulz, 1985): i) reduction in expected taxes, ii) reduction in financial distress, and iii) mitigation of the under-investment.

Reduction in expected taxes hedge motive:
Net Operating Loss Carry-forwards

We use the net operating loss carry-forwards, scaled by the book value of assets (*NOLs/Assets)*, to control for the reduction in expected taxes. According to the Jensen's inequality, if a firm's tax schedule is convex, hedging reduces its expected tax liabilities since the insurance (hedging) can replace the random volatile earnings with the expected earnings. Also, the more pronounced the convexity of the effective tax schedule the greater will be the reduction in expected taxes through hedging (Mayers & Smith, 1982; Smith & Stulz, 1985). This information is obtained from the 10ks of the selected firms for all the 5 years. Most of the previous literature has used this proxy to control for tax convexity. We expect a positive relation between NOL and corporate hedging activities (Graham & Smith, 1999, Smith & Stulz, 1985)

Reduction in financial distress costs hedge motive:
Debt ratio

To control for financial distress cost motive for hedging, we use first the debt ratio (*Debt/Assets*), which is the variable used mostly in the previous literature (Knopf et al. 2002; Nance et. al. 1993; Coles et. al. 2006 etc.) to proxy for distress costs. Data of total debt for all five years is obtained from Compustat. Firms with higher distress costs are expected to hedge more as they face higher costs like losing relationship with suppliers and customers (Shapiro and Titman, 1986) in case of a future bankruptcy (Smith and Stulz, 1985, Rogers, 2002). Hence, we expect a positive relation between the total debt and corporate hedging activities.

Interest coverage ratio

The second ratio we use to control for financial distress costs is the interest coverage ratio (*Interest*

Cov ratio), which has not been used extensively in the previous literature (Nance et al. 1993). This variable is defined as the ratio of the EBIT to the interest expenses. Data for interest expense and EBIT is obtained from Thomson Reuters' database. A negative relation between the interest coverage ratio and the hedging activities of the firm is expected.

Mitigation of the under-investment problem
R&D activities

As argued in Smith and Stulz (1985) & Froot et. al. (1993), hedging could be motivated by the mitigation of the under-investment problem. The under investment problem happens when a firm foregoes positive NPV projects induced by shareholders when they realize most of the gains from the investment would go to the bondholders. As a result of that, the bondholders would pay less for the firm's bonds. Thus preventing the different situations when the firm can default on its bond payments would solve the underinvestment problem and it is achieved by hedging as it smoothens the cash flows that the firm receives and reduces volatility. To control for that, we use R&D expenses divided by the total assets (*R&D/Assets*) and expect a positive relation between R&D expenses and hedging activities. Data on R&D activities for all 5 years are obtained from Thomson Reuters' database.

Market/Book value of equity

The second ratio that is used for the mitigation of underinvestment costs is the M/B ratio (*M/B ratio*). It is defined as the ratio of market value of firm to the book value of equity and we expect to observe a positive association between M/B ratio and derivative hedging consistent with previous theories (Geczy et al. 1997) that hedging increases with firm value increases. Data for this variable is obtained from Compustat database.

Capital expenditures scaled by total assets

Even though the M/B ratio and the R&D expenditures are used to proxy for the future growth opportunities, they still are affected by the firm's current spending. Therefore, we use the capital expenditures/assets (*Capex/Assets*) ratio to measure firm's future growth opportunities since this variable contains only the capital spending which is more likely to accurately capture the future long-term growth potential of the firm (Graham & Rogers, 2002, Geczy et. al. 1997).

Firm risk and hedging
Idiosyncratic risk

To account for firm risk, we use firm's idiosyncratic risk (*Idiosrisk*). This is calculated by estimating the standard deviation of excess returns, using daily excess returns data from Crisp/Compustat database (Shen & Zhang, 2013; Rogers, 2002). We expect a negative relation between idiosyncratic risk and hedging activities since higher risk firms would want to take more risks and hedge less with derivatives.

Dividend yield

Some firms use alternatives to hedging strategies like paying dividends to shareholders. To the extent that dividend-paying firms are considered to be conservative we expect a positive association between dividend yield (*Dividend yield*) and hedging (Nance et. al. 1993). Data for the dividend yield is obtained from the COMPUSTAT database.

Other control variables
Foreign sales to total sales ratio

The effect of foreign sales to total sales (*Foreign/Total sales*) on hedging activities is expected to be positive since more foreign sales correspond to more foreign exchange risk. Fok et. al., (1997) and Allayannis & Ofek (2001) suggest that companies with foreign sales have also foreign denominated debt that makes them exposed to interest rate (IR) risk as well which, in turn, motivates them to use IR derivatives.

Firm size

Using the logarithm of the total assets (*Log Assets*) to proxy firm size, the relationship between firm size and hedging could be positive or negative (Nance et. al., 1993). A positive relationship between hedging and the book value of assets can be expected since bigger firms hedge more compared to smaller firms as there are costs associated with setting up a risk management program and bigger firms benefit from economies of scale. On the other hand, a negative relation between hedging and firm size is expected if bankruptcy costs are high since these direct costs are likely to be higher for smaller firms compared to larger firms causing the former to hedge more (Warner, 1977). Also, a negative relation is conjectured if firms are subject to high information asymmetries because they will be compelled to take more risks and consequently engage in less hedging (O'Brien & Bhushan, 1990).

Insider ownership

Firms that have higher information asymmetry between managers and shareholders tend to hedge more (Breeden and Vishwanathan (1998); DeMarzo & Duffie, 1991). Thus firms with higher insider ownership (*Insider own*) should hedge less and as a result we expect a negative link between insider ownership and derivative hedging. We use the logarithm of the insider ownership percentage to measure its impact on hedging.

Quick ratio

Quick ratio (*Quick ratio*) is a proxy for the liquidity of the firm. We expect a negative relation between Quick ratio and hedging since firms which are more liquid have low hedging incentives and thus they are expected to make lower use of derivatives (Opler, 1999, Nance et. al., 1993).

CEO characteristics variables
Financial education and technical education

Financial and technical education variables (*Fin education & Tech education*) are binary variables and are set equal to 1 if a CEO has any financial/technical educational background (or technical education), and 0 if he does not have finance/technical background. Hence, we expect CEOs with past finance/technical background to be more cognizant of the risk of not hedging against volatility in interest rates, foreign exchange and commodity positions, and so favor more hedging.

CEO tenure

CEOs with greater tenure (*CEO Tenure*) are more likely to hedge, as they would be reluctant to take more risk to attain higher returns in contrast to CEOs who just joined the company and want to pursue riskier initiatives in an attempt to impress the board and shareholders. CEO tenure is measured by the total number of years the CEO is in the current position.

Military experience

The effect of military experience on hedging can be positive or negative. Kilgore et al., (2008) show that combat exposure increases risky behavior and, therefore, a negative relation between CEO military experience (*Military*) and hedging is expected. On the other hand, Benmelech and Frydman (2015) report that military experience is associated with risk-averse corporate policies and so a positive relation between hedging and military experience is expected. The military experience is a dummy variable that is set equal to 1 if a CEO has military experience and 0 otherwise.

Job tenure

The total number of years the CEO worked in a company (*Job Tenure*) has also the potential to affect the hedging decisions of the firm. CEOs with higher employment in a company they run are expected to engage in greater hedging, since the need to build their reputation by taking more risk is less (Gibbons and Murphy, 1992).

Chairmanceo

This is a binary variable whose value is set equal to 1 if a CEO is also the chairman of the board (*Chairman/CEO*) and 0 otherwise. CEOs who are also serving as the chairman of the board would be more conservative and less inclined to take risks as they have to answer to the board members if the risks did not pay off and so they are expected to hedge more. On the other hand, combining the CEO and Chairman roles implies a higher concentration of power and, therefore, these CEOs are likely to take more risks as they do not have to consult with the Chairman and/or respond to the board members therefore they are anticipated to hedge less. Consequently, the sign of Chairman/CEO could be positive or negative.

Age

We include age of the CEO (*CEO age*) as an explanatory variable to investigate its effects on hedging. The sign on the hedging variable could be positive or negative. Holmstrom (1999), Hirshleifer and Thakor (1992) among others find a negative relation between age and hedging while Serfling (2014), Prendergast and Stole (1996), Hambrick and Mason (1984) among others, show that younger CEOs take more risk. In line with the CEO life cycle literature, Pan et al. (2016) argues that an inverse U-shaped relationship could also emerge.

Finance career and technical career

Both these variables are dummy variables (*Finance career & Technical career*) and set equal to 1 if a CEO has worked in a financial/technical firm before joining the current firm and 0 otherwise. Therefore, CEOs with financial or technical experience, in accord with the prediction of the model of Gervais and Odean (2001), are expected to be more risk tolerant and overconfident. Therefore, they are expected to hedge less.

MBA Education

This variable is set equal to 1 if the CEO has a MBA degree (*MBA*) and 0 otherwise. Similar with the above variable, acquiring a MBA degree makes a CEO overconfident and so they are expected to hedge less and take more risks (Gervais and Odean, 2001). Beber and Fabbri (2012) find the MBA degree variable to be mildly significant and negative in line with the overconfident model of Gervais and Odean (2001).

Previous number of companies worked before current company

This variable denotes the number of companies the CEO has worked before joining the current firm (*No of Comps*). Beber and Fabbri (2012) use this variable and find it to be negative and mildly significant in predicting currency hedging, since overconfident CEOs are less risk averse (Gervais and Odean, 2001) On the other hand, greater experience acquired through working in many firms would make the CEOs cognizant about the different types of risk (IR, CP and FX) and so they are expected to hedge more. Therefore, the sign of this variable could be positive or negative.

EMPIRICAL RESULTS

Descriptive statistics

Looking at the summary statistics in Table 1, the average total Delta for the CEO option portfolio is 10.39 million while average total Vega is 4.768 million. Both the Delta and Vega values are large compared to the previous literature (Knopf et al. 2002, Beber and Fabbri, 2012, Rogers, 2002). This could be because in this study we are using large Fortune 500 firms which have significant exposure to various kinds of risks. The average total CEO cash compensation (salary plus bonus) is 1.49 million while inside debt is 7.9 million. The reason for the large inside debt could be because the average CEO in our sample is 56 years old and so he is associated with the firm over a longer period. The average CEO stock equity for our sample is \$543.99 million which is expected since my sample set is the

Fortune 500 firms. The debt to assets ratio is 0.46 which is comparatively high compared to the previous literature (Knopf et al. 2002), which is around 0.2-0.3. The reason for this can be that the firms in our sample are large and we have used a different time setting. An average firm in our sample has foreign sales of about 29% of total sales suggesting that firms in our sample generate a significant part of their revenues overseas. The average CEO age is 56 years old and has worked in the company for about 18 years. This implies that most of the CEOs in our sample are experienced and are in the firm for a long period of time. Average CEO- tenure is 7 years. An average CEO in our sample has worked in about 2 firms before joining the current firm. This implies that CEOs have previous risk management experience and are expected to be more conservative (Sundaram and Yermack, 2007). Also, the derivatives to total assets ratio equals 0.10 implying that an average firm in our sample hedges 10% of its total assets. This low value is consistent with the evidence from Guay & Kothari (2003) who found that derivatives hedging are only a small part of the non-financial firms' risk profile.

Table 2 shows the total average derivatives broken down by year. The total notional derivatives usage has increased from 2008 to 2012 suggesting that firms have increased their hedging in recent years. A similar trend can be seen for hedging with Foreign exchange (FX) and Interest Rate (IR) derivatives while no such trend is observed in commodity derivatives. The total interest rate (IR) derivatives represent 50.7% of the total derivatives while foreign exchange derivatives correspond to 41.25% of the total derivatives. This further validates the inclusion of interest rate derivatives in our analysis rather than just focusing on foreign exchange derivatives or commodity derivatives as has been the case in most of the previous studies (Beber & Fabbri, 2012; Tufano, 1996). The use of IR derivatives into the analysis of hedging provides an additional element of differentiation between this paper and previous studies. Thus, the inclusion of IR derivatives, a significant component of corporate hedging activity ignored in previous studies, recognizes the importance of interest rate risk arising from the exposure of firms to debt motivating them to employ different debt derivative instruments such as interest rate swaps, forwards swaps, and interest rate futures, etc. to hedge their exposure to interest rate risk.

Table 1. Summary statistics

This table presents the descriptive statistics of the variables used in the analysis. Inside debt is the total pension and deferred compensation of CEO compensation. Total derivatives are addition of total notional values of interest rate, commodity and currency contracts. Idiosyncratic risk is the standard deviation of stock returns. Total observations are 1446. For detailed description of variables see Appendix.

Variable	**Mean**	**Std Dev**	**Min**	**Max**
Inside Debt (millions)	8.878	0.1994	0.015	232.6
Idiosyncratic Risk	0.02	0.0122	0.006	0.114
Total Cash Compensation (millions)	1.494	0.022	0.081	0.31
Total Option comp value (Current, exercisable & un-exercisable options-in millions)	2.33	11.39	0	218
NOL Carryforwards- scaled by Assets	0.013	0.0548	0	1.412
Delta of CEO Compensation (millions)	10.39	180.9	0	5275
Vega of CEO Compensation (millions)	4.768	123.3	0	4195
CEO Age (in years)	56.18	6.255	37	85
CEO Stock Compensation (millions)	543.99	0.7444	0	1179
Debt to Assets ratio	0.468	1.920	0	47.89
Tobin's q	2.87	17.43	-4.43	32.66
Market to Book ratio	7.9	371.6	0.009	469
Foreign sales/Total Sales	0.287	0.284	0	1.058
Total sales (billions)	2.01	3.089	0.4745	26.50
Total assets (billions)	2.691	5.860	0.384	79.78
R&D Expense-scaled by Assets	0.0144	0.0361	0	0.399
Capital Expenditures- scaled by Assets	0.0725	0.245	0	4.588
Total Derivatives- scaled by Assets	0.100	5.949	0.0001	2.44
CEO Job Tenure (in years)	17.65	11.50	0.500	45
Previous No. of Comps worked	1.848	1.859	0	9
CEO Tenure (in years)	7.024	6.076	0.500	35.50
Dividend Yield	0.0124	0.0182	0	0.146
Interest Coverage ratio	26.91	168.3	0.06	4,762
Quick Ratio	0.946	0.819	0.13	7.568
Insider Ownership	0.0101	0.0627	0	.63

Table 2: Notional values of total derivatives broken down by year

This table presents the total notional values of derivatives broken down by year (from 2008 to 2012). The three types of derivatives included here are the interest rate derivatives, commodity derivatives and foreign exchange derivatives. All average derivative values are in millions. In parentheses is the percentage of a specific derivative relative to total hedging.

Year	No. obs.	Mean of the three types of derivatives (in millions)			Total mean derivatives (In millions)	Derivatives/ Assets
		Interest rate (IR)	Commodity (COMM)	Foreign exchange (FX)		
2008	274	948.04 (58.68%)	104.62 (6.48%)	562.93 (34.84%)	1615.59	0.08
2009	293	1592.59 (51.3%)	93.68 (2.85%)	1415.22 (45.8%)	3101.49	0.1
2010	294	1702.71 (45.18)	183.75 (2.7%)	1614.23 (43.37%)	3500.7	0.11
2011	295	2186.68 (58.11%)	165.45 (9.39%)	1315.56 (32.5%)	3667.69	0.108
2012	290	1696.87 (40.23%)	399.45 (10.1%)	2087.66 (49.76%)	4183.98	0.109

Managerial compensation and hedging

Table 3, Panel A, presents regression results based on five different specifications. First, we test the individual effect of Delta, Vega and Delta & Vega jointly in the first three baseline specifications. In Panel B, we replicate the analysis using Delta, Vega and Delta & Vega in logs. Then, we add the control variables to test the three theories of Smith & Stulz (1985), and control for firm size, liquidity, alternatives to hedging, and managerial entrenchment, including variables to account for CEO characteristics, CEO education and past experiences. We did not find the CEO total Delta and Vega to be significant in any of the specifications in both Panels. This result is in contrast with the evidence of Knopf et al. (2002) and Graham and Rogers (2002) who found Delta to be statistically significant using only one year data. Also, our result contradicts the evidence of Beber and Fabbri (2012) who report Vega to be mildly significant. Jointly, these findings seem to suggest that CEO risk sensitivity measured through Delta and Vega is not a significant predictor of a CEO's hedging policies. To put it differently, most option like compensation contracts designed to motivate CEOs to hedge less do not appear to work.

The coefficients of CEO inside debt, CEO stock equity and CEO cash compensation, all proxies for CEO risk-aversion, are also statistically insignificant. Overall, these results show that none of the CEO risk preference measures are significant in any of the regression models.

Firm characteristics and hedging

Due to the previously reported mixed results of the relationship between hedging and firm characteristics, we test the hedging motives as described in Smith and Stulz (1985) in a panel data set in Model 4 of Table 3. All the previous papers with exclusion of Beber and Fabbri (2012), tested the three hedging motives, based on the reduction in financial distress, reduction in expected tax and mitigation of the under-investment problem theories, using a cross-sectional dataset. To test the financial distress hedging motive, the debt ratio and interest coverage ratio are used. Both ratios, as shown in Table 3, are not significant. Testing the reduction in expected taxes hedging motive, we use NOL carry-forwards scaled by total assets to proxy for reduction in expected taxes. This variable is also not significant in any of the models suggesting that hedging is not motivated by expected tax considerations. Finally, the mitigation of the underinvestment problem as a hedging motive is examined using the following three variables; R&D/Assets, Market/Book ratio and Capex/Assets. None of the three variables are significant in any of the models. In sum, these results fail to provide support to any of the three hedging theories of Smith & Stulz (1985).

Looking at the control variables, firm size is statistically significant and negative consistent with previous evidence (Warner, 1977). The foreign sales is positive and statistically significant suggesting that firms with greater foreign sales tend to hedge more. The idiosyncratic firm risk is also positive and significant.

Managerial characteristics and hedging

In this section, we add CEO characteristics in the regression analysis to examine their impact on hedging. Looking again at the reported results in Table 3 (Model 5 and 6), we observe that CEO age is not significant in any of the two main regression models suggesting that CEO age is not linked with derivative hedging. Similarly, CEO tenure is not significant but CEO job-tenure is significant in both of our main regressions. This indicates that CEOs with longer job tenure tend to hedge more as their job is most likely to be safer and they do not have to take risks to impress the board of directors. Male and CEO duality are not significant implying that sex and CEO duality have no influence on total derivatives hedging.

Finally, prior CEO experience, measured by the number of companies they headed in the past, is significant but the sign is positive contradicting the results of Beber and Fabbri (2012) who find that prior CEO experience exerts a negative effect on foreign exchange (FX) hedging. This result can be attributed to the fact that more experienced CEOs, based on having prior CEO experience in other firms, appear to be aware of the different kinds of risks and their likely impact on firm's riskiness and their own job security which, in turn, seem to motivate them to engage in more hedging. Previous CEO education measures are not significant in any of the models suggesting that corporate derivatives hedging is not affected by past financial/technical education. The CEO experience variables are also not significant in any of the regression models. In sum, our results suggest that CEO job tenure and CEO experience, in other companies before joining the current firm, are positively related to hedging.

Table 3: The relation between firm's derivatives usage and CEO risk preference measures

This table presents the fixed effects regression results where the dependent variable is log of derivatives/assets ratio and the main independent variables are the CEO compensation, and characteristics variables. All variable definitions are provided in detail in Appendix A, C, D and E. Statistically significant variables are marked in bold. Presented in parentheses are the robust standard errors which are clustered at the firm level. The superscripts ***, **, and * indicate significance at 1%, 5%, and 10%, respectively.

Panel A: Non-log risk preferences (Delta and Vega)

VARIABLES	(1) Model 1	(2) Model 2	(3) Model 3	(4) Model 4	(5) Model 5	(6) Model 6
CEO Total Delta	2.00e-10		4.20e-10	-2.09e-09	-2.03e-09	-2.05e-09
	(3.12e-10)		(8.86e-10)	(2.27e-09)	(2.27e-09)	(2.28e-09)
CEO Total Vega		2.13e-10	-3.17e-10	-1.27e-09	-1.28e-09	-1.30e-09
		(4.21e-10)	(1.19e-09)	(1.36e-09)	(1.36e-09)	(1.36e-09)
CEO Share Equity				1.03e-10	1.02e-10	1.03e-10
				(8.27e-11)	(8.28e-11)	(8.29e-11)
CEO Cash comp				4.54e-08	4.74e-08	4.50e-08
				(4.70e-08)	(4.72e-08)	(4.73e-08)
CEO Inside debt				-1.01e-08	-9.55e-09	-1.05e-08
				(2.06e-08)	(2.06e-08)	(2.07e-08)
NOLs/Assets				-0.275	-0.109	-0.0734
				(1.360)	(1.362)	(1.364)
Debt/Assets				-0.0714	-0.0666	-0.0688
				(0.0863)	(0.0868)	(0.0870)
R&D/Assets				-1.289	-2.046	-2.013
				(4.745)	(4.766)	(4.804)
Capex/Assets				-0.0997	-0.118	-0.138
				(0.348)	(0.348)	(0.349)
Idiosrisk				84.03***	83.55***	85.00***
				(28.21)	(28.53)	(28.63)
Log (Assets)				-0.569***	-0.578***	-0.627***
				(0.178)	(0.181)	(0.183)
Quick ratio				0.0720	0.0649	0.0564
				(0.121)	(0.121)	(0.122)
Dividend yield				1.709	0.493	0.283
				(3.530)	(3.589)	(3.611)
Interest Cov ratio				-0.000996	-0.00116	-0.00108
				(0.000826)	(0.000831)	(0.000837)
Insider ownership				-0.203	-0.145	-0.159
				(0.682)	(0.685)	(0.690)
Foreign/Total sales				1.228***	1.202***	1.171***
				(0.424)	(0.426)	(0.429)
M/B ratio				0.00153	0.00139	0.00144
				(0.00186)	(0.00186)	(0.00187)
Log (Job tenure)					0.198*	0.234**
					(0.107)	(0.110)
Log (CEO tenure)					-0.0324	-0.0336
					(0.0816)	(0.0829)
Male					-0.0847	-0.105
					(0.446)	(0.478)
Military					-0.307	-0.481
					(0.421)	(0.437)
Chairman/CEO					0.0449	-0.00847

					(0.238)	(0.242)
Log (Age)					0.0684	0.409
					(0.847)	(0.867)
Log (No. of comps)					0.426**	0.475***
					(0.177)	(0.182)
Fin Education						0.0963
						(0.329)
Tech Education						-0.286
						(0.361)
Finance career						0.0984
						(0.302)
Technical career						0.594
						(0.433)
MBA						0.202
						(0.216)
Constant	-1.948***	-1.947***	-1.948***	9.169**	8.510*	7.999
	(0.0329)	(0.0329)	(0.0331)	(4.203)	(5.150)	(5.172)
Industry	Y	Y	Y	Y	Y	Y
Year	Y	Y	Y	Y	Y	Y
Observations	1,444	1,444	1,444	1,267	1,258	1,255
R-squared	0.000	0.000	0.000	0.036	0.044	0.049
Number of Company1	302	302	302	269	268	268

Panel B: Log risk preferences (Delta and Vega)

VARIABLES	(1) Model 1	(2) Model 2	(3) Model 3	(4) Model 4		
Log (Delta)	-0.0300					
	(0.0459)					
Log (Vega)	-0.00402					
	(0.00251)					
Vega/Delta		-0.000517	-0.000547	-0.000666		
		(0.00198)	(0.00197)	(0.00198)		
Log (Stock equity)	0.0163	-1.64e-05	0.000240	0.00156		
	(0.0278)	(0.0170)	(0.0174)	(0.0175)		
Log (cash)	0.0317	0.0335	0.0322	0.0286		
	(0.0311)	(0.0311)	(0.0313)	(0.0315)		
Log (inside debt)	-0.0245	-0.0236	-0.0207	-0.0119		
	(0.0182)	(0.0182)	(0.0186)	(0.0193)		
Controls (as in Panel A)	Y	Y	Y	Y	Y	Y
Industry	Y	Y	Y	Y	Y	Y
Year	Y	Y	Y	Y	Y	Y
Observations	1,444	1,444	1,444	1,267	1,258	1,255
R-squared	0.000	0.000	0.000	0.036	0.044	0.049
Number of Company1	302	302	302	269	268	268

Addressing endogeneity

One of the problems using CEO compensation measures and firm characteristics as control variables to predict derivatives hedging is endogeneity. CEO compensation variables like CEO inside debt, CEO Delta, CEO Vega, CEO cash compensation and CEO stock compensation are all predictors of firm characteristics like firm size, R&D investment, and firm risk. In other words, since option like contracts encourage CEO risk taking, CEOs with higher option like compensation values get self-selected into firms with higher R&D investment, larger firm size, and higher idiosyncratic risk. To address this problem, we follow the method employed by Shen and Zhang (2013). First, we regress each of the CEO compensation variables (CEO inside debt, CEO cash, CEO equity, CEO Delta, and Vega) against the firm characteristics (D/E ratio, firm size, firm risk, M/B ratio, R&D investment, lagged free cash flow) and managerial characteristic variables (CEO tenure and age). Table 4 presents the results. Then, we use the residuals (excess values) of these CEO compensation variables as independent variables for the fixed effect regression, which partially removes the endogeneity problem. Using the excess compensation variables fixed-effect regressions are re-estimated and Table 5 reports these results. All the variables have the same sign and statistical significance as in Table 3.

Table 4: Determinants of CEO compensation

This table presents OLS regressions of CEO compensation (i.e., cash, inside debt, stock equity, CEO total Vega, and CEO total Delta) on firm characteristics as in Shen and Zhang (2013). Robust standard errors are presented in parentheses which are clustered at the firm level. ***, **, and * indicate significance at 1%, 5%, and 10%, respectively. Variable definitions are provided in detail in Appendix A, C, D & E.

VARIABLES	(1) CEO Delta	(2) CEO Vega	(3) CEO Shares	(4) CEO In Debt	(5) CEO Cash
CEO Cash comp	3.612	1.915	0.115	161.0	
	(5.805)	(3.991)	(0.172)	(183.5)	
Log CEO tenure	1.382e+07	8.053e+06	328,029	5.623e+08**	28,221
	(8.420e+06)	(5.790e+06)	(251,007)	(2.662e+08)	(45,103)
Log (Sales)	-7.545e+06	-4.121e+06	-749,493**	-2.772e+08	129,440**
	(1.077e+07)	(7.406e+06)	(322,260)	(3.405e+08)	(57,566)
CEO Age	-4.471e+06***	-3.052e+06***	129,701***	-1.244e+08***	43,078***
	(1.422e+06)	(977,693)	(42,417)	(4.495e+07)	(7,499)
M/B ratio	-51,194	-30,456	-3,650	-1.803e+06	-359.2
	(197,405)	(135,737)	(6,032)	(6.241e+06)	(1,058)
Idiosrisk	1.438e+08	1.309e+08	1.467e+09***	1.639e+09	4.341e+06
	(9.199e+08)	(6.325e+08)	(2.736e+07)	(2.908e+10)	(4.927e+06)
Debt/Assets	-1.077e+06	-70,047	432,299**	-1.105e+08	3,189
	(7.106e+06)	(4.886e+06)	(204,609)	(2.247e+08)	(38,073)

Lag FCF/Asset	2.418e+07	1.313e+07	-5.110e+06***	9.276e+08	-162,240
	(6.402e+07)	(4.402e+07)	(1.859e+06)	(2.024e+09)	(342,965)
Constant	4.373e+08	2.746e+08	-1.521e+07*	1.330e+10	-3.749e+06**
	(2.958e+08)	(2.034e+08)	(8.705e+06)	(9.352e+09)	(1.581e+06)
Industry	Y	Y	Y	Y	Y
Year	Y	Y	Y	Y	Y
Observations	1,192	1,192	1,121	1,192	1,192
R-squared	0.101	0.086	0.887	0.164	0.781

Table 5: The effect of CEO risk preference measures on firm's derivative hedging: Addressing endogeneity

This table presents fixed effect regression after controlling for endogeneity where the dependent variable is the log of the derivative to total assets ratio. We use the Shen and Zhang (2013) method to control for endogeneity. We use the CEO compensation variables as dependent variables and run regressions as shown in table 4. The residuals of the model that are estimated in Table 3 (Excess_Vega, Excess_Delta, Excess_Shares, Excess_Cash and Excess_Indebt) are saved as excess CEO compensation and used as independent variables in this regression. Robust standard errors are presented in parentheses which are clustered at the firm level. ***, **, and * indicate significance at 1%, 5%, and 10%, respectively. Variable definitions are provided in detail in Appendix A, C, D & E.

VARIABLES	(1) Model 1	(2) Model 2	(3) Model 3	(4) Model 4	(5) Model 5	(6) Model 6
Excess_Delta	2.27e-10		5.03e-10	-1.78e-09	-1.89e-09	-1.90e-09
	(3.16e-10)		(9.02e-10)	(2.30e-09)	(2.34e-09)	(2.34e-09)
Excess_Vega		2.38e-10	-3.97e-10	-1.23e-09	-1.31e-09	-1.33e-09
		(4.27e-10)	(1.22e-09)	(1.38e-09)	(1.40e-09)	(1.40e-09)
Excess_Shares				9.41e-11	9.94e-11	1.01e-10
				(8.32e-11)	(8.51e-11)	(8.53e-11)
Excess_Cash				1.66e-08	2.31e-08	2.08e-08
				(4.89e-08)	(4.93e-08)	(4.94e-08)
Excess_Indebt				-1.49e-08	-1.38e-08	-1.50e-08
				(2.05e-08)	(2.10e-08)	(2.10e-08)
NOLs/Assets				-1.030	-0.719	-0.630
				(2.089)	(2.094)	(2.102)
Debt/Assets				-0.105	-0.102	-0.104
				(0.0905)	(0.0910)	(0.0912)
R&D/Assets				-2.471	-3.184	-3.284
				(5.171)	(5.191)	(5.239)
Capex/Assets				-0.106	-0.122	-0.144
				(0.357)	(0.357)	(0.358)
Idiosrisk				84.71**	86.54**	86.78**
				(40.84)	(41.53)	(41.69)
Log (Assets)				-0.630***	-0.643***	-0.692***
				(0.192)	(0.195)	(0.197)
Quick ratio				0.0819	0.0712	0.0633
				(0.124)	(0.124)	(0.125)
Dividend yield				1.884	0.815	0.558
				(3.703)	(3.781)	(3.813)
Interest Cov ratio				-0.00102	-0.00117	-0.00110
				(0.000846)	(0.000850)	(0.000856)
Insider own				-0.182	-0.106	-0.128

				(0.699)	(0.701)	(0.707)
Foreign/Total sales				1.295***	1.273***	1.249***
				(0.449)	(0.450)	(0.454)
M/B ratio				0.00145	0.00127	0.00135
				(0.00209)	(0.00209)	(0.00210)
Log (Job tenure)					0.170	0.198
					(0.122)	(0.125)
Log (CEO tenure)					-0.0126	-0.0141
					(0.0895)	(0.0909)
Male					-0.138	-0.193
					(0.482)	(0.525)
Military					-0.265	-0.440
					(0.432)	(0.451)
Chairman/CEO					0.112	0.0566
					(0.254)	(0.258)
Log (Age)					-0.147	0.262
					(0.993)	(1.024)
Log (No. of comps)					0.442**	0.476**
					(0.197)	(0.201)
Fin Education						0.108
						(0.357)
Tech Education						-0.263
						(0.382)
Finance career						0.112
						(0.314)
Technical career						0.589
						(0.461)
MBA						0.203
						(0.234)
Constant	-1.905***	-1.905***	-1.905***	10.57**	10.90*	10.17*
	(0.0367)	(0.0367)	(0.0367)	(4.665)	(5.914)	(5.949)
Industry	Y	Y	Y	Y	Y	Y
Year	Y	Y	Y	Y	Y	Y
Observations	1,190	1,190	1,190	1,116	1,112	1,109
R-squared	0.001	0.000	0.001	0.044	0.052	0.056
Number of Company1	253	253	253	240	240	240

Since none of the education and compensation variables are significant in our regression models, we introduce interaction terms as shown in Table 5. The interaction variables are introduced because CEOs in our sample have multiple education degrees and varied work experiences with technical and finance background. Additionally, the use of the interactive terms allows us to capture the variability in the CEO risk preference and characteristics variables in our sample. The results of the interaction terms are presented in Table 6. In Model 1, we include interaction terms between CEO education variables and the CEO work experience measures. Specifically, the interaction variables added in Model 1 are for CEOs with an MBA degree and finance job experience (*MBA*Fin career*), CEOs with MBA degree and finance education (*MBA*Fin edu*), CEOs having some technical/engineering education and financial career experience (*Tech edu*Fin career*), and CEOs with finance & technical education with some financial experience (*Fin edu*Tech edu*Fin career*). In Model 2, Total CEO Delta is interacted with the CEO characteristic variables. The interaction variables added are the CEO age and CEO total Delta (*CEO Age* Total CEO Delta*), CEO tenure and Total CEO Delta (*CEO Tenure* Total CEO Delta*) and Chairman/CEO and Total CEO Delta (*Chairmanceo*Total CEO Delta*). In Model 3, we interact the CEO characteristic variables with CEOs inside debt compensation. The interaction variables added are the CEO Insidedebt and CEO age (*CEO Insidedebt*CEO age*), CEO Insidedebt and CEO tenure (*CEO Insidedebt*CEO tenure*) and CEO Insidedebt and Chairman/CEO (*CEO Insidedebt*Chairmanceo*). Using the interaction variables, we find the tenure*delta and chairman*delta variable to be significant and positive. This suggests that CEOs who also act as chairman and having high tenure combined with high delta tend to hedge more. The result is consistent with the notion that high tenured CEOs and dual acting CEOs (chairman & CEO) are more conservative and, as a result, they tend to hedge more. We also find the age*delta interactive term to be statistically significant and negative suggesting that older CEOs with high delta hedge less. This result suggests that CEO inside debt compensation designed to motivate CEOs to act conservatively does not appear to be effective. This result, could also attributed to the fact that the CEO inside debt compensation in our sample is less while stock equity is high (543 million) which is likely to make them to behave more as risk-seeking. The signs and significance of the other variables are consistent with the ones reported in Table 5.

Table 6: Interaction of CEO characteristic/experience/education variables with CEO risk preference measures

This table presents fixed effect regression the results. The dependent variable is log of the derivatives to assets ratio. In model 1, we interacted the education variables with the work experience variables. The interaction variables added are the MBA*Fin career (CEO's holding an MBA degree and has finance job experience), MBA*Fin edu (CEO with MBA degree and finance education), Tech edu*Fin career (CEO with technical education and financial career background), and Fin edu*Tech edu*Fin career (CEO with finance & technical education and financial job experience). In model 2, Delta is interacted with the CEO characteristic variables. The interaction variables added are the CEO Age* Total CEO Delta, CEO Tenure*Total CEO Delta and Chairmanceo*Total CEO Delta. In model 3, CEO inside debt variable is interacted with the CEO characteristic variables. The interaction variables added are the CEO Age* CEO Inside Debt (CEO age with the CEO inside debt variable), CEO Tenure*CEO Inside Debt (CEO Tenure variable with the inside debt variable) and Chairmanceo*CEO Inside Debt (Chairman/CEO variable with the CEO inside debt variable).

VARIABLES	(1) Model 1	(2) Model 2	(3) Model 3
Excess_Delta	-1.91e-09	6.27e-08***	6.13e-08***
	(2.35e-09)	(2.07e-08)	(2.07e-08)
Excess_Vega	-1.33e-09	-1.65e-08***	-1.64e-08***
	(1.40e-09)	(6.09e-09)	(6.10e-09)
Excess_Shares	1.01e-10	-1.34e-09**	-1.33e-09**
	(8.54e-11)	(5.30e-10)	(5.31e-10)
Excess_Cash	2.07e-08	-2.95e-08	-3.77e-08
	(4.95e-08)	(6.09e-08)	(6.37e-08)
Excess_Indebt	-1.48e-08	-1.14e-08	-4.84e-08
	(2.10e-08)	(2.09e-08)	(1.04e-07)
NOLs/Assets	-0.670	-1.218	-1.378
	(2.107)	(2.104)	(2.107)
Debt/Assets	-0.102	-0.0300	-0.0403
	(0.0915)	(0.0977)	(0.105)
R&D/Assets	-3.029	-2.670	-2.423
	(5.269)	(5.256)	(5.264)
Capex/Assets	-0.146	-0.142	-0.143
	(0.358)	(0.358)	(0.358)
Idiosrisk	86.92**	97.17**	44.99
	(41.79)	(41.75)	(155.5)
Log (Assets)	-0.687***	-0.837***	-0.868***
	(0.198)	(0.206)	(0.206)
Quick ratio	0.0579	0.0222	0.0172
	(0.125)	(0.126)	(0.126)
Dividend yield	0.459	-5.003	-4.161
	(3.830)	(4.147)	(4.188)
Interest Cov ratio	-0.00114	-0.00119	-0.00129
	(0.000865)	(0.000862)	(0.000863)
Insider Own	-0.114	-0.248	-0.301
	(0.710)	(0.713)	(0.713)
Foreign/Total sales	1.286***	1.301***	1.324***
	(0.457)	(0.459)	(0.460)
M/B ratio	0.00137	0.00149	0.00167
	(0.00210)	(0.00211)	(0.00219)
Log (job tenure)	0.181	0.176	0.155
	(0.127)	(0.127)	(0.128)
Log (CEO tenure)	0.000661	-0.0876	0.000331
	(0.0931)	(0.138)	(0.151)

Male	-0.129	-0.109	-0.276
	(0.545)	(0.542)	(0.558)
Military	-0.374	-0.328	-0.425
	(0.457)	(0.456)	(0.464)
Chairman/CEO	0.0818	0.213	0.0279
	(0.265)	(0.268)	(0.297)
Log (Age)	0.131	-3.692**	-3.957**
	(1.048)	(1.735)	(1.841)
Log (No. of comps)	0.441**	0.364*	0.333
	(0.220)	(0.220)	(0.221)
Fin Education	0.166	0.207	0.382
	(0.516)	(0.514)	(0.526)
Tech Education	-0.546	-0.506	-0.497
	(0.497)	(0.496)	(0.496)
Finance career	0.150	0.181	0.211
	(0.538)	(0.536)	(0.538)
Technical career	0.691	0.617	0.500
	(0.494)	(0.492)	(0.499)
MBA	0.317	0.327	0.309
	(0.271)	(0.270)	(0.271)
MBA*Fincare	-0.127	-0.192	-0.0978
	(0.671)	(0.668)	(0.670)
MBA*Finedu	-0.312	-0.397	-0.477
	(0.600)	(0.598)	(0.602)
Techedu*Fincare	0.164	0.244	0.185
	(0.671)	(0.668)	(0.671)
Finedu*Techedu*Fincareer	0.532	0.305	0.293
	(1.016)	(1.014)	(1.023)
Age*Delta		-2.07e-08***	-2.03e-08***
		(6.79e-09)	(6.79e-09)
CEO Tenure*Delta		4.36e-08***	4.34e-08***
		(1.61e-08)	(1.62e-08)
Chairman/CEO*Delta		3.61e-08**	3.62e-08**
		(1.62e-08)	(1.62e-08)
Age*Inside Debt			1.20e-08
			(2.86e-08)
CEO Tenure*Inside Debt			-1.16e-08*
			(6.73e-09)
Chairman/CEO*Inside Debt			2.51e-08
			(2.57e-08)
Constant	10.55*	29.28***	31.93***
	(6.012)	(9.131)	(10.35)
Industry	Y	Y	Y
Year	Y	Y	Y
Observations	1,109	1,109	1,109
R-squared	0.058	0.071	0.075
Number of Company1	240	240	240

Corporate hedging by derivative instrument

We turn our focus on each of the three derivative instruments separately (interest rate derivatives, foreign exchange derivatives and commodity derivatives) and replicate the previous fixed effect regression analysis by derivative instrument, controlling for endogeneity. As noted earlier, most of the previous literature has used only foreign exchange derivatives as the main dependent variable to proxy derivative hedging (Allayannis and Weston, 2001; Beber and Fabbri, 2012) assuming currency risk is far greater and more important than other sources of risk. However, as Table 2 reveals interest rate derivatives usage represents 50.68% while currency derivatives usage is 41.25% of total derivatives usage with commodity derivatives lagging considerably (8.4%). None of the CEO risk preference variables are significant for any of the FX, IR and COMM derivatives confirming our previous result with the total derivatives. Consistent with our previous evidence, based on the total derivatives hedging, we failed to find any support for the three hedging theories of Smith and Stulz (1985) for each derivative hedging instrument (FX, IR and COMM). Finally, looking at the influence of CEO characteristics and education on hedging by instrument, we find no significant association between the former and hedging at the individual derivatives level for all three derivative hedging instruments.

Table 7: Fixed effect regressions of each type of derivatives (FX, IR and COMM) on CEO risk preference measures

This table reports the fixed effect regression results. The dependent variable is the foreign exchange (FX) derivative (Model 1), interest rate (IR) derivatives (Model 2), and commodity (COMM) derivatives (Model 3). The excess risk preference variables residual Vega (Excess_Vega), residual Delta (Excess_Delta), excess shares ownership (Excess_Shares), excess CEO cash compensation (Excess_CEO Cash), and Excess inside debt (Excess_Indebt) are used after controlling for endogeneity. Robust standard errors are presented in parentheses which are clustered at the firm level. ***, **, and * indicate significance at 1%, 5%, and 10%, respectively. Variable definitions are provided in detail in Appendix A, C, D & E.

VARIABLES	(1) FX	(2) IR	(3) COMM
Excess_Delta	-3.28e-09	-1.07e-09	3.32e-09
	(2.43e-09)	(2.58e-09)	(2.39e-09)
Excess_Vega	-1.30e-09	-9.86e-10	-3.23e-09**
	(1.45e-09)	(1.54e-09)	(1.43e-09)
Excess_Shares	1.34e-10	6.55e-11	6.11e-11
	(8.83e-11)	(9.39e-11)	(8.71e-11)
Excess_Cash	4.18e-08	5.58e-08	2.21e-08
	(5.12e-08)	(5.44e-08)	(5.04e-08)
Excess_Indebt	1.26e-08	1.61e-08	1.38e-08

	(1.92e-08)	(2.05e-08)	(1.90e-08)
NOLs/Assets	-1.466	1.830	-1.335
	(2.178)	(2.318)	(2.148)
Debt/Assets	0.00362	-0.0736	-0.0822
	(0.0943)	(0.100)	(0.0930)
R&D/Assets	-1.379	-3.165	3.420
	(5.426)	(5.773)	(5.349)
Capex/Assets	-0.0695	-0.228	-0.0106
	(0.370)	(0.394)	(0.365)
Idiosrisk	-12.18	57.79**	-0.890
	(27.38)	(29.13)	(27.00)
Log (Assets)	-0.345*	-0.619***	0.0389
	(0.202)	(0.215)	(0.199)
Quick ratio	-0.171	0.114	-0.0948
	(0.129)	(0.137)	(0.127)
Dividend Yield	-3.578	-6.656	-16.58***
	(3.898)	(4.147)	(3.843)
Interest cov ratio	0.000265	-0.00137	0.000414
	(0.000887)	(0.000944)	(0.000874)
Insider ownership	-0.372	-0.627	0.0527
	(0.733)	(0.780)	(0.723)
Foreign/Total sales	-0.134	1.209**	1.132**
	(0.471)	(0.501)	(0.464)
M/B ratio	0.00102	0.000297	0.000736
	(0.00216)	(0.00230)	(0.00213)
Log (Job Tenure)	0.0561	-0.150	-0.0153
	(0.129)	(0.138)	(0.127)
Log (CEO Tenure)	0.0464	-0.0981	-0.0875
	(0.0940)	(0.100)	(0.0927)
Male	-0.315	0.178	-0.188
	(0.544)	(0.578)	(0.536)
Military	-0.224	-0.774	-0.0916
	(0.467)	(0.497)	(0.461)
Chairman/CEO	-0.225	-0.182	0.196
	(0.267)	(0.284)	(0.263)
Log (age)	0.339	1.962*	-0.175
	(1.055)	(1.123)	(1.040)
Log (No of comps)	-0.0778	-0.0128	-0.0732
	(0.208)	(0.222)	(0.205)
Fin Education	0.0142	-0.264	-0.316
	(0.370)	(0.394)	(0.365)
Tech Education	-0.460	0.234	-0.00513
	(0.396)	(0.422)	(0.391)
Finance career	-0.115	0.430	-0.177
	(0.326)	(0.346)	(0.321)
Technical career	0.723	0.219	0.661
	(0.478)	(0.508)	(0.471)
MBA	0.112	0.201	0.319
	(0.242)	(0.257)	(0.239)
Constant	5.872	3.876	-0.719
	(5.864)	(6.239)	(5.781)
Industry	Y	Y	Y
Year	Y	Y	Y
Observations	1,111	1,111	1,111
R-squared	0.018	0.044	0.055

Number of Company1	240	240	240

Robustness tests based on single year OLS regressions from 2008-2012

In addition to the fixed effect regression analysis, we also estimate separate single year OLS regressions from 2008 to 2012 for total derivatives and the FX, IR and COMM derivatives, separately. Looking at the total derivatives first, in Table 8: Panel A, for brevity we only report the significant results, the results demonstrate that none of the CEO risk preference measures are significant for any years and as before we find no support for any of the three theories of Smith and Stulz (1985). This evidence coupled with our previous findings, using fixed effect regression, corroborates that CEO risk preference measures do not affect hedging.

We conduct additional robustness tests by using foreign exchange derivatives (FX) and interest rate (IR) derivatives as our dependent variables and undergoing single year OLS regressions. In Table 8, Panel B, we use the foreign exchange derivatives as the dependent variable and again for brevity we report only the variables with significant coefficients. We use the excess CEO risk preference measures after controlling for endogeneity (see Table 4) and fail to find any excess CEO risk preference measures to be significant for all the 5 years for our OLS regressions.

In Table 8, Panel C and D, we use interest rate derivatives and Commodity derivatives respectively as the dependent variable and as before we report only the significant variables. Again none of the variables are consistently significant over the 5 year period. Thus, using the OLS regressions, we fail again to find statistical significance for the CEO risk preference measures. The evidence also shows no support the three hedging theories of Smith & Stulz (1985).

Table 8: OLS single year regressions from 2008 to 2012

Panel A: Relation between total derivatives and CEO risk preference measures

This panel reports OLS single year regression results. The log of Total derivatives/assets ratio is the dependent variable for years 2008 to 2012. Risk preference variables (CEO inside debt compensation, CEO option compensation Vega, Delta, CEO cash compensation and CEO firm shares ownership) are controlled for endogeneity and their excess values are used in the regressions (see table 4 for variables used to control for endogeneity). Only the significant variables are shown in the table. Robust standard errors are presented in parentheses which are clustered at the firm level. ***, **, and * indicate significance at 1%, 5%, and 10%, respectively. Variable definitions are provided in detail in Appendix A, C, D & E.

VARIABLES	(1) 2008	(2) 2009	(3) 2010	(4) 2011	(5) 2012
Tech career					1.38**
					(0.56)
Excess_Delta		$-4e^{-07}$*			
		($2e^{-07}$)			
					$-3.6e^{-08}$
					($1.8e^{-08}$)
Fin Educ		1.3***			
		(0.48)			
Excess_indebt		$-4e^{-08}$*			
		($2e^{-08}$)			
Excess_shares		$4e^{-09}$**			
		($2e^{-09}$)			
Debt/Assets	-0.7*				0.35*
	(0.4)				(0.18)
Log Assets	-0.6*			0.38*	
	(0.32)			(0.19)	
Idiosrisk				49.49**	55.65***
				(20.31)	(17.93)
Tech Educ					-1.15**
					(0.53)
No of comps					0.39*
					(0.22)
Observations	1110	1118	1120	1121	1118
R-squared	0.55	0.66	0.77	0.87	0.76
Industry	Y	Y	Y	Y	Y
Year	Y	Y	Y	Y	Y

Panel B: Relation between Foreign exchange derivatives and CEO risk preference measures

This panel reports OLS single year regression results. The log of foreign exchange derivatives/assets ratio is the dependent variable for years 2008 to 2012. Risk preference variables (CEO inside debt compensation, CEO option compensation Vega, Delta, CEO cash compensation and CEO firm shares ownership) are controlled for endogeneity and their excess values are used in the regressions (see table 4 for variables used to control for endogeneity). Only the significant variables are shown in the table. Robust standard errors are presented in parentheses which are clustered at the firm level. ***, **, and * indicate significance at 1%, 5%, and 10%, respectively. Variable definitions are provided in detail in Appendix A, C, D & E.

VARIABLES	(1) 2008	(2) 2009	(3) 2010	(4) 2011	(5) 2012
Tech educ		-1.43**		-1.14*	
		(0.61)		(0.659)	
R&D/Assets					
Idiosrisk					47.21*

					(24.42)
Excess_shares		$-6.41e^{-09}$***			
		($6.57e^{-09}$)			
Excess_Delta		$-5.73e^{-07}$***			
		($1.93e^{-07}$)			
Excess_Vega		$4.63e^{-07}$***			
		($1.64e^{-07}$)			
No of Comps				0.806***	
				(0.29)	
Log Age		21.27***			
		(6.97)			
Capex/Assets		1.77*			
		(1.01)			
MB ratio		0.009**			
		(0.004)			
Excess_Indebt		$-5.7e^{-08}$**		$-5.9e^{-08}$**	$-7.2e^{-08}$**
		($2.34e^{-08}$)		($2.6e^{-08}$)	($2.5e^{-08}$)
Tech educ		-1.43**			
		(0.61)			
Observations	290	288	289	287	288
R-squared	0.59	0.49	0.66	0.79	0.63
Industry	Y	Y	Y	Y	Y
Year	Y	Y	Y	Y	Y

Panel C. Relation between Interest rate derivatives and CEO risk preference measures

This panel reports OLS single year regression results. The log of foreign exchange derivatives/assets ratio is the dependent variable for years 2008 to 2012. Risk preference variables (CEO inside debt compensation, CEO option compensation Vega, Delta, CEO cash compensation and CEO firm shares ownership) are controlled for endogeneity and their excess values are used in the regressions (see table 4 for variables used to control for endogeneity). Only the significant variables are shown in the table. Robust standard errors are presented in parentheses which are clustered at the firm level. ***, **, and * indicate significance at 1%, 5%, and 10%, respectively. Variable definitions are provided in detail in Appendix A, C, D & E.

VARIABLES	(1) 2008	(2) 2009	(3) 2010	(4) 2011	(5) 2012
Foreign/total sales			2.15***	1.33*	
			(0.76)	(0.73)	
Idiosrisk				58.44**	53.81*
				(27.5)	(28.21)
NOLs/Assets	8.69*				
	(4.73)				
Tech Educ				-1.842*	
				(0.74)	
Observations	287	290	291	288	289
R-squared	0.494	0.497	0.868	0.475	0.655
Industry	Y	Y	Y	Y	Y
Year	Y	Y	Y	Y	Y

Panel D. Relation between Commodity derivatives and CEO risk preference measures

This panel reports OLS single year regression results. The log of commodity derivatives/assets ratio is the dependent variable for years 2008 to 2012. Risk preference variables (CEO inside debt compensation, CEO option compensation Vega, Delta, CEO cash compensation and CEO firm shares ownership) are controlled for endogeneity and their excess values are used in the regressions (see table 4 for variables used to control for endogeneity). Only the significant variables are shown in the table. Robust standard errors are presented in parentheses which are clustered at the firm level. ***, **, and * indicate significance at 1%, 5%, and 10%, respectively. Variable definitions are provided in detail in Appendix A, C, D & E.

VARIABLES	(1) 2008	(2) 2009	(3) 2010	(4) 2011	(5) 2012
Male		-2.28*			
		(1.35)			
CEO Tenure		-1.01*			
		(0.54)			
Div Yield	100.88**		-18.75*		-19.93*
	(49.41)		(11.11)		(10.34)
Excess_shares		$6.11e^{-09}$**	$-6.01e^{-09}$*		$-8.91e^{-09}$*
		($2.83e^{-09}$)	($3.39\ e^{-09}$)		($4.4e^{-09}$)
Excess_Delta		$-6.16e^{-07}$**	$5.94\ e^{-07}$*		$8.67e^{-07}$*
		($2.78e^{-07}$)	($3.37\ e^{-07}$)		($4.4e^{-07}$)
Excess_Vega		$5.28e^{-07}$**			$-8.46e^{-07}$*
		($2.37e^{-07}$)			($5.06e^{-07}$)
Idiosrisk					46.39*
					(27.15)
Log Age		27.47**			
		(12.06)			
Technical career			-1.25*		
Observations	277	281	285	280	279
R-squared	0.54	0.45	0.81	0.54	0.66
Industry	Y	Y	Y	Y	Y
Year	Y	Y	Y	Y	Y

CONCLUSION

Theory and previous empirical studies advocate that CEO risk preferences affect hedging. This paper questions this claim and investigates whether CEO managerial compensation and CEO characteristics affect corporate derivative hedging decisions in a 5-year time series setting in contrast to earlier studies relying on cross-sectional datasets. We find the CEO Vega and Delta to be statistically insignificant, before and after we control for endogeneity. None of the other CEO risk preference measures used (inside debt, CEO share compensation and cash compensation) are significant. Overall, our findings suggest that managerial risk preferences do not affect corporate hedging.

Regarding the role of firm characteristics on hedging, we find no support for any of the three theories of Smith and Stulz (1985). Looking at managerial characteristics, we find that the CEO job-tenure exerts significant and positive impact on hedging suggesting that CEOs with longer job tenure tend to be more conservative and hedge more. In addition, the evidence shows that CEOs with more work experience before joining the current firm prefer to hedge more as a result of being less risk-tolerant.

Overall, our findings help to understand why the results of the previous empirical literature on the relation between managerial risk preferences and derivative hedging are inconsistent. Not finding any of the managerial risk preference measures, used in our analysis over a 5-year period, to have a significant impact on hedging and not finding any of the three hedging theories of Smith & Stulz (1985) to be significant leads to the conclusion that the significant results uncovered in previous studies are more likely due to their focus on a specific year since they relied on cross-sectional data and/or focusing exclusively on currency derivatives than on all derivatives used by corporations to hedge interest rate and commodity risk.

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APPENDIX A. Firm Variables

This Appendix presents company variables in which the variables we derive are italicized.

- Idiosrisk – This variable captures the idiosyncratic risk and is the standard deviation of the daily excess returns.
- NOLs/Assets- Net operating loss carry-forwards divided by the total book value of the assets.
- Debt/Assets –Total debt to total assets.
- M/B ratio- This variable is calculated by dividing the market price of the stock to the book value per share of stock (BPS). BPS is calculated by dividing the book value of assets by the total shares outstanding.
- Foreign/Total sales- International sales revenue divided by the total sales revenue.
- Capex/Assets - Logarithm of the total capital expenditure of the firm divided by the total book value of the assets.
- Quick ratio- (Current assets- Inventories)/current liabilities.
- R&D/Assets –Total Research and Development expenses of the firm.
- Insider ownership- Insider stock ownership (%) of the company shares by the CEO.
- Dividend yield- Total dividend yield of the company calculated by dividing the dividend by the current stock price
- Interest Cov ratio - Interest coverage ratio of the firm calculated by dividing the EBIT by the interest expense.
- Assets - Total book value of the assets.

APPENDIX B: Delta & Vega calculation using Black-Scholes Option Pricing Model

In this appendix, we first present how we derive CEO stock option values, deltas, and vegas and then we define other variables.

The Black and Scholes (1973) model for valuing European call options modified for dividend payments as in Merton (1973) is as follows.

Value = S exp (-d*T)*N (d_1) - X exp (-r*T)*N (d_2) (1)

where,

$$d_1=(\ln\left(\frac{S}{X}\right)+T(r-d+\frac{\sigma^2}{2}))/\sigma\sqrt{T}$$

$$d_2 = d_1 - \sigma\sqrt{T}$$

N (.) = Cumulative probability function for the normal distribution

S = share price of stock at fiscal year-end

d = Dividend yield as of fiscal year-end.

X = Exercise price of the option.

r = Risk-free rate. US T-bond yields corresponding to the option's time to maturity are used.

d= Annualized standard deviation of daily stock returns measured over 120 days prior to fiscal year-end.

T = Remaining years to maturity of option.

As in Core and Guay (2002), the "**Delta**" and "**Vega**" measures are the option values sensitivity with respect to a 1% change in stock price and a 0.01 change in standard deviation, respectively, and are expressed in equations (2) and (3) below.

$$\frac{\partial value}{\partial S} * \frac{S}{100} = \exp\{-dT\}\, N(d1) * \frac{S}{100} \qquad (2)$$

$$\frac{\partial value}{\partial S} * 0.01 = 0.01 * [\exp\{-d * T\} N'(d2) S\sqrt{T}] \qquad (3)$$

Where N' (.)= normal probability density function.

Exact values of exercise price and time to maturity are obtained from proxy statements for current year option grants. For options granted in prior years, I use the Core and Guay (2002) algorithm. I estimate average exercise prices by subtracting the ratio of realizable value of options to the number of options (for both exercisable and un-exercisable options) from fiscal year-end stock prices. Time to maturity is set at 1 year less than the time to maturity of the current year's grant (or 9 years if no new grant is made) for un-exercisable options. Time to maturity is set at 3 years less than the time to maturity of exercisable options (or 6 years if no new grant is made). Delta and Vega values for shares of stock held are assumed to be equal to 1 and 0, respectively.

APPENDIX C: CEO compensation variables:

- Total CEO Delta- Total Delta of the CEO compensation portfolio (sum of Delta of CEO current options, exercisable options & un-exercisable options & Delta of CEO stock options).
- Total CEO Vega - Total Vega of the CEO compensation portfolio (sum of Vega of CEO current options, exercisable options & un-exercisable options).

- CEO Inside Debt - The inside debt is the sum of the CEO's deferred compensation and pension benefits.
- CEO Cash Comp - Total salary + bonus of the CEO's compensation portfolio.
- CEO Share Equity - Total stock equity compensation of the CEO's compensation.
- Excess_ Indebt- Excess inside debt holdings of the CEO.
- Excess_Cash- Excess cash compensation (These are the residuals after controlling for endogeneity using the Shen & Zhang, 2013 method).
- Excess_Shares- Excess stock equity compensation (These are the residuals after controlling for endogeneity using the Shen & Zhang, 2013 method).
- Excess_Delta - Excess total CEO Delta compensation (These are the residuals after controlling for endogeneity using the Shen & Zhang, 2013 method).
- Excess_Vega- - Excess total CEO Vega compensation (These are the residuals after controlling for endogeneity using the Shen & Zhang, 2013 method).

APPENDIX D: CEO personal characteristics variables:

- CEO Age - Age of the CEO in years.
- Job Tenure - The number of years the CEO is in the current firm.
- CEO Tenure - The tenure of the executive as the CEO of the firm.
- Male- dummy variable with value=1 if male and 0 otherwise.
- Military- dummy variable with value =1 if CEO has military experience and 0 otherwise.
- Chairman/CEO- dummy variable with value=1 if CEO is the Chairman and CEO and 0 if CEO is not the chairman.
- No of Comps- Previous number of companies worked before joining the current firm.

APPENDIX E: CEO education and past experience variables:

- MBA- dummy variable with value=1 if CEO has MBA and 0 otherwise.
- Tech education- dummy variable with value=1 if CEO has some sort of technical education or 0 otherwise.
- Fin education- dummy variable with value=1 if CEO has any finance education or 0 otherwise.
- Finance career- dummy variable with value=1 if CEO has some sort of finance experience in the past before joining the current firm.

- Technical career- dummy variable with value=1 if CEO has some sort of technical job experience in the past before joining the current company.

APPENDIX F: CEO interaction variables:

- MBA*Fincare- CEOs with MBA degree and having a Financial career.
- MBA*Finedu- CEOs with MBA degree and who have some sort of Financial education.
- Tech edu*Fincare- CEOs who have technical education and who have some kind of financial job experience before.
- Finedu*Tech edu*Fin career- CEOs having a financial as well as a technical education background and also who have a financial job experience before joining the current firm.
- Age*Delta- This variable interacts the log of the age of the CEO with the Delta of the option portfolio of the CEO.
- CEO Tenure*Delta- This variable interacts the log of the CEO tenure with the Delta of the option portfolio of the CEO.
- Chairman/CEO*Delta- This variable interacts the Chairmanceo dummy variable with the Delta of the option portfolio of the CEO.
- Chairman/CEO*Inside Debt - This variable interacts the Chairmanceo dummy variable with the Delta of the option portfolio of the CEO.
- CEO Tenure*Inside Debt - This variable interacts the CEO tenure variable with the CEO inside debt of the option portfolio of the CEO.
- Age* Inside Debt - This variable interacts the log of the age of the CEO with the inside debt of the option portfolio of the CE

CHAPTER 2

CEO RISK PREFERENCES, HEDGING INTENSITY, AND FIRM VALUE

ABSTRACT

Using a unique multiyear data set, we examine the hedging intensity and market value sensitivity of firms run by CEOs with different risk preferences. Unlike previous studies, we find hedging intensities of risk-seeking and risk-averse CEOs to be strikingly similar. We also find that, when the average firm experiences an extreme (three-standard-deviation) change in interest rates, commodity prices, or foreign exchange rates, its derivatives portfolio creates only modest gains, regardless of CEO risk preferences. These findings are consistent with the view that hedging is just an insurance policy and not a firm value increasing strategy.

INTRODUCTION

Modigliani and Miller (1958) argue that, in the absence of transaction costs, taxes, and information asymmetries, hedging financial risk should not affect firm value. In fact, the traditional full-information perfect capital market model of the firm does not say much about why firms hedge and implies that whether firms hedge or not is irrelevant to shareholders because they can undo any risk management activities implemented by the firm at the same cost. For instance, Culp and Miller (1995) state that "most value maximizing firms, in fact, do not hedge." However, in the real world, markets are imperfect and inefficient and, thus, according to the common view, corporate hedging decisions are expected to affect firm value by reducing firm risk. The increased volatility in interest rates (IRs), currencies (FXs), and commodities (COMMs) in recent years has led to the proliferation of hedging instruments and techniques, raising the fundamental question of whether hedging does matter to firm value. Unsurprisingly, the divergence of views of hedging on firm value and the development of numerous hedging strategies using different hedging derivatives have motivated several studies, which have thus far produced mixed results. For example, Ahmed et al. (2010) and Bartram et al. (2011), have analyzed the valuation effect of total derivatives using non-US data, while Hagelin (2003) and Clark et al. (2006) have only looked at the effects of currency hedging on firm value. Clark et al. (2006), using French companies, did not find a relation between currency hedging and firm value and Hagelin (2003), looking at Swedish firms, reports a positive relation between firm value and currency hedging. As far as we know, no previous paper has looked at the effect of all derivatives on firm value for

US firms. In addition, the relation between firm value and hedging of US firms is mixed. While Allayannis and Weston (2001), Allayannis et al. (2001), Pramborg (2004), Carter et al. (2006) and Chaudhry et al. (2014) have found a positive association between hedging and firm value, Lookman (2004), Dan et al. (2005), Jin and Jorion (2006), and Bartram et al. (2011) did not find any relation. More recently, Stulz (2013) has argued that hedging is just an insurance policy that is unlikely to affect firm value, implying that firm value creation arises through other corporate decisions, such as firm investments and high financial leverage. Whether hedging affects firm value, as measured by Tobin's Q, remains debatable and warrants investigation, since there is no clear empirical consensus.

In this paper, we first examine whether hedging affects firm value, using all types of derivatives: interest rate (*IR)*, commodity (*COMM)*, and foreign exchange (*FX*) derivatives. To draw comparisons with previous studies, we also examine the effect of individual derivatives (*IR, FX,* and *COMM*) on firm value. For example, Tufano (1996), Allayannis et al. (2001), and Jin and Jorion (2006), among others, have looked at the impact of either *FX* or *COMM* derivatives on firm value. In addition, the effect of derivatives on firm value in most previous studies has only been investigated in an unconditional environment, with the exception of Allayannis et al. (2012). Specifically, those authors analyze the impact of currency derivatives on firm value conditional on the firm's quality of management (i.e., poorly vs. well-managed firms) and corporate governance (i.e., internal vs. external). In this paper, however, we look at how derivatives affect firm value conditional on CEOs' risk-averse or risk-seeking sensitivity (risk preferences), inferred from the nature of CEO compensation contracts. Intuitively, we want to determine if CEO compensation packages, designed to encourage risk-tolerant (risk-averse) behavior, affect firm value. Even though CEOs decide corporate hedging policies, it is the shareholders who design the CEO compensation contracts that determine CEO incentives to hedge less (risk seeking) or more (risk averse) (Stulz, 1984; Smith and Stulz, 1985). To address this issue, we use CEO compensation measures to capture CEO risk preferences that have been shown to affect hedging decisions in previous studies, such as the total CEO compensation delta, total CEO compensation, CEO stock ownership, CEO cash compensation, and CEO inside debt.[4]Specifically, risk-averse CEOs

[4] Rogers (2002) and Knopf et al. (2002) find delta to be positively related to hedging, while Cole et al.

are characterized by a higher CEO total delta, high inside debt compensation, high cash compensation, and/or high stock compensation. On the other hand, risk-seeking CEOs are expected to have higher vega compensation. In addition, a firm's hedging intensity is conjectured to vary with CEO risk preferences. Unlike previous studies, we compare the hedging intensity, measured by total derivatives over total assets, of firms run by risk-averse and risk-seeking CEOs. We also determine the market value sensitivity of the total derivatives portfolio to extreme changes in the underlying asset for firms led by risk-averse and risk seeking CEOs, separately. To the best of our knowledge, no previous study has looked at both firm hedging intensity and market value sensitivity conditional on CEO risk preferences to gauge the extent to which hedging matters. Only Guay and Kothari (2003) have examined the market value sensitivity of hedging, but without conditioning on CEO risk preferences.

This paper contributes to the literature in many important ways. First, to the best of our knowledge, this is the first study to explore the effect of total derivatives hedging on firm value for US firms. The previous literature has focused only on one type of derivatives hedging (*IR, FX, or COMM* derivatives hedging), a fraction of total derivative usage, to determine how firm value is affected discretely by a single derivative instrument. Also, the impact of the total use of derivatives on firm value has been studied only with non-US firms. Second, unlike most of the previous literature, which has examined the effect of hedging

(2006) and Guay (1999) find vega to be negatively related. Edmans and Liu (2011) and Belkhir and Boubaker (2013) find CEO inside debt to be positively related to hedging, while Rogers (2002) and Stulz (1996) find stock ownership to be a statistically significant variable for hedging. Knopf et al. (2002) find CEO cash compensation to be positively related to hedging.

on firm value in an unconditional environment, except for Allayannis et al. (2012), who conditioned the valuation effect of hedging on the quality of management and corporate governance characteristics, we examine the impact of hedging on firm value conditional on CEOs' different attitudes toward risk (i.e., risk-averse vs. risk-tolerant CEOs), controlling for other effects in accord with the previous literature. Specifically, we examine if the impact of hedging on firm value is higher in firms run by risk-averse CEOs than in those run by risk-seeking CEOs. While several studies have shown that the nature of CEO compensation affects CEO risk preferences and, ultimately, their hedging decisions, they do not focus on the valuation effects of hedging. For instance, while Stulz (1996), Tufano (1996), Knopf et al. (2002), Rogers (2002), Coles et al. (2006), Edmans and Liu (2011), and Beber and Fabbri (2012) have shown that different compensation packages tend to increase (decrease) CEO hedging intensity, their evidence of this relationship is mixed.

Finally, we look at the hedging intensities of risk-averse and risk-seeking CEOs to determine if compensation contracts designed to motivate managerial risk taking (increase risk tolerance) work. No previous study has analyzed the magnitude of derivatives usage for risk-averse and risk-seeking CEOs. Furthermore, we analyze the market value sensitivities of the three types of derivatives to the movement of the underlying asset. That is, we investigate the change in the market value of derivatives with a simultaneous change of IR, COMM and FX rates. We perform this analysis separately for risk-seeking and risk averse CEOs and compare how the usage of derivatives affects firm value for both groups. To conduct this analysis, we adopt the methodology of Guay and Kothari (2003). As far as we know, no other paper has looked at the magnitude of change in firm value due to derivatives hedging for risk-seeking and risk-averse CEOs separately. While Guay and Kothari look at the value creation of total derivatives, they do not address the market value sensitivity of hedging for firms run by risk-seeking and risk-averse CEOs.

One of the problems in analyzing the effect of derivatives on firm value is self-selection bias; that is, firms with specific characteristics have higher derivatives usage, which makes the sample non-random and, therefore, the results sensitive to endogeneity bias (Core and Guay, 1999). To control for endogeneity, we deconstruct the total derivatives and individual derivatives variables into "predicted" and "excess" components. Following Shen and Zhang (2013), we first estimate ordinary least squares (OLS) regressions of derivatives on the dependent and independent variables' factors known to affect hedging, such as research and development (R&D), size, and leverage, in accord with previous studies (e.g., Geczy et al., 1997). The residuals from these regressions are the excess derivatives variables that have been purged of factors that affect firm value. This approach, also used by Caliskan and Doukas (2015), mitigates the endogeneity problem. To ensure the robustness of our results, we control for endogeneity using a two-stage least squares (2SLS) method and our main results remain the same.

In addition, unlike previous studies (Ahmed et al., 2010; Chaudhry et al., 2014) that rely on binary variables to account for derivatives hedging, we use continuous variables analogous to those of Campello et al. (2011) and Marami and Dubois (2013) as our main independent variables. As our dependent variable, we use Tobin's Q, defined as the ratio of total assets minus the book value of shareholder equity plus the market value of equity to the book value of assets (Rossi and Laham, 2008; Bartram et al., 2011). Consistent with the previous literature, our sample consists of nonfinancial firms that use derivatives for hedging purposes.

Using hand-collected data for 332 firms and 1446 firm–year observations, we obtain the following results. The usage of total derivatives (i.e., *IR*, *COMM*, and *FX* derivatives) does not affect firm value, as measured by using Tobin's Q in an unconditional setting. This result is inconsistent with the evidence obtained by previous studies (Allayannis et al., 2001; Allayannis and Weston, 2001), which reported a positive relation between firm value and derivatives, using only FX derivatives, which represent less than half (41%) of firms' total derivatives usage in our sample. Due to the above inconsistent result, we next examine the individual effects of the three types of derivatives on firm value and find that none of the *FX*, *IR* and *COMM* derivatives, used independently, have any significant effect on firm value. Our results hold even when we control for endogeneity using the method explained above. In sum, our findings show that firm value is not significantly affected by total derivatives use or any of the individual derivatives (*FX, IR,* or *COMM*). While our results are consistent with the results obtained by Jin and Jorion (2006), Brown et al. (2006), and Tufano (1996), who also use just one type of derivatives, we are more interested in examining the valuation effects of corporate hedging conditional on CEO risk preferences, since previous studies show that CEO risk preferences influence corporate decisions and valuation.[5]

In the context of corporate hedging, risk-averse CEOs are expected to have a stronger hedging preference than their risk-seeking (risk-tolerant) counterparts, as it is generally believed (i.e., risk-seeking CEOs expose firm assets to greater risks). Therefore, conditioning our investigation on CEOs' risk preferences allows us to determine if they result in diverse hedging intensities, an issue that has not been addressed in previous studies, and how they affect firm value. Specifically, we address these issues by splitting our sample into risk-averse and risk-seeking CEOs based on the median value of five CEO risk preference measures. CEOs with risk preference measures above their median values are labeled as having a high value of that characteristic. Consistent with the previous literature (e.g., Mian, 1996; Knopf et al., 2002; Graham and Rogers, 2002; and Rogers, 2002), we use high vega CEO compensation to proxy for risk-seeking CEOs and high delta CEO compensation, high share equity compensation, high inside debt compensation, and high cash compensation to proxy for risk-averse CEOs. Since risk-averse and risk-seeking CEOs are only differentiated through their compensation measures, we can accurately reflect how CEO risk preferences affect firm value through derivatives hedging. For each of the five CEO risk preference measures, we run pooled OLS regressions for risk-averse and risk-seeking CEO groups separately.

[5] For example, Tufano (1996), Guay (1999) Knopf et al. (2002), Rogers (2002), Beber and Fabbri (2012), and Cassel et al. (2012)show that the nature of CEO risk preferences gauged through the nature of compensation contracts affects corporate hedging decisions and, more recently, Caliskan and Doukas (2015) have reported that CEO risk preferences influence dividend policy.

Our results show that derivatives hedging is not associated with firm value as measured through Tobin's Q for firms run by either risk-seeking or risk-averse CEOs, suggesting that hedging is not influenced by the nature of CEO compensation contracts designed to raise or lower the level of CEO risk tolerance. We re-examine the influence of *IR, FX, and COMM* derivatives hedging on firm value conditional on CEO risk preferences and find a similar pattern with total derivatives hedging. Our main results remain unchanged when we control for endogeneity. In sum, our evidence shows that derivatives hedging in unconditional and conditional settings does not matter to firm value.

Interestingly, we also find that the hedging intensity levels, measured through total derivatives scaled by assets, of firms run by risk-seeking and risk-averse CEOs are fairly similar (around 0.10–0.11), a finding that has never being recorded in the literature. The similarity in hedging intensity between the two CEO types demonstrates that CEOs are inherently risk averse and the nature of compensation packages considered to motivate CEOs with convex compensation contracts to hedge less does not appear to be effective. That is, risk-seeking CEOs' hedging intensity being similar to that of their risk-averse counterparts suggests that CEO compensation contracts intended to motivate greater risk tolerance (hedge less) do not alter their risk preferences. This new evidence seems to suggest that the hedging decisions of CEOs with convex (non-linear) compensation contracts, in a world of asymmetric information, are probably motivated by the idea of "locking in" performance and reputation rather than increasing firm value.[6] Next, we look at the market value sensitivities of the derivatives portfolio for all firms in our sample (unconditional setting) to extreme changes in the underlying asset, and find that the average firm's total derivative market value sensitivity is $3.7 billion. That is, when the average firm in our sample experiences a three-standard-deviation change in *IR*s, *COMM* prices, and *FX* rates, the entire derivatives portfolio increases firm value by $3.7 billion. This value is small compared to the average firm's total assets ($29.6 billion) and total sales ($19.9 billion). Namely, the sensitivity of the derivatives portfolio to changes in the price of the underlying asset is equal to 13% of total assets and 19% of total sales. This result could explain why firms hesitate to hedge their total IR, FX, and COMM risk using derivatives (Bodnar et al., 1995) in favor of other strategies, such as operational hedging, exchange rate and foreign currency debt to manage financial risk (Aretz and Bartram, 2010).

Next, we analyze if the impact of hedging on firm value differs between risk seeking and risk-averse CEOs, using the Guay and Kothari (2003) procedure (see Appendix A for a detailed description of this method). We find no significant differences.

Specifically, our evidence shows that risk-seeking CEOs (high vega) who hedge with *IR, FX, and COMM* derivatives increase firm value by approximately $4.55 billion, which is just 12.8% of total assets and 21% of total sales, while risk-averse CEOs (high delta, high cash, high inside debt and/or high share compensation) increase firm value by $5.21 billion, which is only 13.2% of total assets and 20.5% of total sales. In sum, the market value sensitivities of

[6] While this conjecture is not addressed in this study, it warrants future investigation.

derivatives (i.e., increases in firm value due to derivatives usage) in terms of total assets (13%) and total sales (21%) are modest and similar, regardless of whether firms are managed by risk-averse or risk-seeking CEOs. The firm value sensitivity results lend support to our hedging intensity evidence, which indicates that hedging preferences for both risk-seeking and risk-averse CEOs are similar, consistent with the argument put forth by Guay and Kothari (2003) that, on average, firm value creation due to corporate derivatives usage is minimal compared to the firm's complete risk exposure.

Overall, the results seem to imply that CEO compensation contracts designed to encourage risk taking for the sake of value creation do not work. Put differently, regardless of CEO risk preferences, hedging seems to be used by CEOs as an insurance policy rather than as a strategy to increase firm value per se. Shareholders' value maximization interests are better served through the more efficient management of a firm's assets and operations (Myers, 1977; Peltzman, 1977; Morck and Yeung, 1991; Smith and Watts, 1992; Froot et al., 1993; Geczy et al., 1997) than through derivatives hedging, a strategy that can only help to protect firm value (Stulz, 2013). In addition, our results hold even when we control for endogeneity using Shen and Zhang's (2013) method for total derivatives, as well as for *IR, FX,* and *COMM* derivatives.

Since we did not find derivatives usage to be associated with increase in firm value, we further analyze whether the value creation is related to other sources and find the debt ratio to be positively related to firm value for both risk-seeking and risk-averse CEOs, suggesting that firms with higher debt in their balance sheet realize higher market capitalization as measured by Tobin's Q. This evidence is consistent with several previous papers that have documented the importance of capital structure decisions in firm value (Taub, 1975; Givoly et al., 1992; Petersen and Rajan, 1994; Roden and Lewellen, 1995; Champion, 1999; Ghosh et al., 2000; Hadlock and James, 2002; Abor, 2005; Mollik, 2005; Berger and Bonaccorsi di Patti, 2006).

The remainder of this paper is organized as follows. Section 2 provides a brief description of the literature and hypothesis development. Section 3 describes the sample and methodology. Section 4 presents the results. Section 5 concludes the paper.

LITERATURE REVIEW AND HYPOTHESIS DEVELOPMENT

Financial hedging and firm value

While the impact of hedging variable corporate risks on firm value has received increasing academic attention in recent years, to date the evidence remains mixed. Previous studies that have examined the relation between firm value and derivatives have focused on only one type of derivative or a specific industry. Jorion (1990), for example, focusing on US multinational firms finds no relation between *FX* derivatives and firm value. Allayannis et al. (2001) find that firms that use operational hedging along with *FX* derivatives improve firm value. Allayannis and Weston (2011) find that firms that hedge with *FX* derivatives have higher firm value compared to non-hedgers with a value premium of 4.87%. In addition, Mackay and Moeller (2007) note that *FX* hedging is associated with higher firm value. Graham and Rogers (2002) report that tax benefits from using derivatives hedging increases a firm’s market value by 1.1%.

Gay et al. (2011) state that firms using derivatives benefit shareholders by experiencing lower *IR* spreads and being subject to less strict covenants in their loan agreements (even though they did not explicitly check the impact of IR on firm value). Relatedly, Chen and King (2014) estimate that the bond yield spread for derivatives users is, on average, 49.1 basis points lower than for non-derivative users.

Looking at the strand of literature focused on specific industries, Tufano (1996) examines corporate risk management activity in the North American gold mining industry and finds little empirical support for the predictive power of theories that view risk management as a means of maximizing shareholder value. Campello et al. (2011) study the effect of hedging on corporate financing and investment decisions and find that derivatives users receive more favorable financing terms in their loan agreements than non-users do. Carter et al. (2006) find that the use of fuel hedging by US airline firms increases firm value by over 5% compared to non-hedgers in the same industry. Jin and Jorion (2006), addressing the impact of hedging on firm value for oil and gas firms, find no relation between firm value and hedging. Some studies have looked at the valuation effect of total derivatives (*IR*, *FX*, and *COMM*) across industries using foreign instead of US data. For example, Bartram et al. (2011), using international data from 47 countries, find only a weak relation between firm value and hedging. Similarly, Ahmed et al. (2010) use data from UK firms for all derivatives and find mixed results. Hagelin et al. (2007), analyzing Swedish firms, find a positive relation between firm value and hedging. Bartram et al.

(2009), looking at a sample of companies from 50 countries, report *IR* hedging, but not *FX* hedging, to be associated with firm value.

While the previous hedging studies have examined the valuation effects of *FX* and *IR* derivatives, they have ignored the impact of *COMM* and total derivatives on firm value. Ahmed et al. (2010) and Bartram et al. (2011), however, look at total derivatives but use non-US data. In this paper, unlike prior studies, we initially examine the effect of total derivatives and then the impact of individual derivatives on firm value in an *unconditional setting* for Fortune 500 US firms in a multi-year setting. Based on the above-mentioned arguments, we arrive at the following hypotheses.

H1: Total derivatives hedging is positively related to firm value.

H2: Individual derivatives (IR, FX, and COMM) hedging is positively related to firm value.

CEO compensation, hedging preferences, and firm value

We now look at the effect of derivatives on firm value conditional on CEO risk preferences, proxied by several measures. Jensen and Meckling (1976) and Jensen (1986), in their seminal agency theory papers, discuss how the principal agent designs compensation contracts to motivate the risk-averse agent, or CEO in our case, given the

CEO's vast undiversified wealth, to take more risks by compensating the agent through more option-like compensation contracts. In line with the agency-theoretic view, one would expect CEOs with more option-like compensation contracts to exhibit high risk tolerance and, thus, hedge less, while their risk-averse counterparts engage in more hedging. While the nature of CEO compensation contracts has been shown to affect firms' hedging decisions (Tufano, 1996; Guay, 1999; Knopf et al., 2002; Rogers, 2002; Beber and Fabbri, 2012; Cassell et al., 2012) by increasing (decreasing) CEO hedging intensity, the evidence is mixed.

Stulz (1984) argues that managers are inherently risk-averse and not diversified, implying that they are expected to hedge more. Hence, while the author conjectures that managerial risk aversion could influence corporate risk management policy, an interesting but implicit point is that hedging might be beneficial to managers but not necessarily to firm value. Similarly, Tufano (1996) argues that firms whose managers hold more options (risk-seeking) manage less risk and firms whose managers hold more stock (risk-averse) manage more risk, suggesting that managerial risk aversion could affect corporate risk management policy. More recently, Stulz (2013) has argued that hedging is just an insurance policy and does not add direct value to the firm. The above discussion leads to our next hypothesis,

H3: Market value sensitivities to derivatives hedging for firms run by risk-averse or risk-seeking CEOs are unlikely to differ much.

CEO compensation can be split up to gauge a CEO's risk-seeking or risk-averse preferences (Knopf et al., 2002). Following the literature, we define CEOs as risk averse if they have high inside debt, a higher delta, high cash compensation, and/or high share compensation. Similarly, we define risk-seeking (risk-tolerant) CEOs as having high vega compensation and we thus expect them to hedge less.

In sum, risk-averse CEOs should hedge more while risk-seeking CEOs should hedge less with derivatives (Knopf et al., 2002; Guay, 1999; Coles et al., 2006).

Using the above arguments, we first analyze how the total delta and total vega of CEO compensation affect the relation between hedging and firm value. We define delta as the sensitivity of the option price to the stock price, while vega is the sensitivity of the option price to stock volatility. Option-based compensation contracts are one way shareholders (owners) incentivize managers to take on more risk, owing to their convex payoff structure (e.g., Smith and Stulz, 1985; Tufano, 1996; Rajgopal and Shevlin, 2002; Hemmer et al., 1999). Guay (1999) and Rogers (2002), among others, find vega to be negatively related to hedging, while Knopf et al. (2002) and Coles et al. (2006) report delta to be positively related to hedging. Second, we analyze the potential effects of CEO stock ownership on the relation between hedging and firm value. Assuming the stock portfolio has a linear payoff function, the presence of stock equity in the CEO's total compensation portfolio increases the undiversifiable component of the CEO's wealth and the CEO thus an incentive to hedge more. In line with this point, Rogers (2002) and Stulz (1996) find firms headed by CEOs with higher stock ownership engage in more hedging.

In accord with our earlier discussion and previous empirical evidence (Knopf et al. (2002) and Rogers (2002)), since high cash compensation increases the undiversified component of a CEO's total compensation portfolio it is expected to motivate greater hedging. Therefore, next we analyze the effect of CEO cash compensation on the relation between hedging and firm value. Lastly, we examine whether CEO inside debt compensation influences the relation between hedging and firm value. Inside debt is defined as the sum of the CEO's deferred compensation and pension benefits. Greater CEO inside debt would make the CEO more risk averse, since taking risks could jeopardize the CEO's inside debt (post-retirement compensation). In line with this view, Sundaram and Yermack (2007), Edmans and Liu (2011), and Wei and Yermack (2011), among others, show that high levels of CEO inside debt are associated with less risk-taking decisions and thus the implementation of conservative firm-level policies. In the context of this study, CEOs with greater inside debt compensation are expected to engage in more hedging. We thus arrive at our main hypotheses, as follows.

H4: Firms run by risk-averse (risk-seeking) CEOs are expected to hedge more (less) with total derivatives, resulting in greater (lower) firm value.

H5: Firms run by risk-averse (risk-seeking) CEOs are expected to hedge more (less) with individual IR, FX, and COMM derivatives, resulting in greater (lower) firm value.

SAMPLE SELECTION AND DATA

Data sources and description

The sample consists of Fortune 500 companies. We chose the Fortune 500 list of companies for our analysis for two reasons. First, most Fortune 500 companies are big and more likely to use derivatives compared to smaller firms, since the usage of derivatives is costly (Nance et al., 1993; Bodnar et al., 1995; Hentschel and Kothari, 2001; Graham and Rogers, 2002). Second, the Fortune 500 list encompasses companies from a wide array of industries and, thus, negates any industry bias. Consistent with the previous literature, we use Tobin's Q as the main dependent variable to proxy for firm value (Allayannis et al. 2001; Allayannis et al., 2012). Tobin's Q is defined as the ratio of total assets minus the book value of shareholder equity plus the market value of equity to the book value of assets. Total notional derivatives, specified as hedging by a firm, is our main independent variable.

The initial sample consists of 500 companies from which commercial banks, diversified financials, and securities and insurance companies are omitted, since their purpose for using derivatives is completely different (mainly speculation) from that of nonfinancial firms (mainly hedging risk). That reduces the sample size to 434 companies for which we have Tobin's Q information for five years. The gross notional derivative information (our main independent variable) is obtained from the Mergent Online database which has 10-K data of all 434 companies from 2008 to 2012. The five-year sample period yields 2170 firm–year observations. To search for derivatives, we use the terms *hedge, notional, swaps, foreign currency*, and *forwards*. We use the notional value of derivatives from the 10-K information to account for firms' derivatives usage. The previous literature has used the fair value of derivatives as the dependent variable, but its use is plagued by many problems.

First, the total notional quantity value of derivatives is the aggregate number the CEO has used for hedging that correctly depicts the CEO's risk-taking preference and currently denotes the total price of the established hedge. Since the market value (fair value) of derivatives changes with the economy, this source is not reliable for evaluating a firm's total financial risk. Second, very few firms report fair value in their 10-K information and, thus, using fair value would result in the loss of many observations. On the other hand, all firms reveal the total notional quantity value of derivatives in their 10K data. Thus, firms that do not report the notional value of their derivatives in their 10-K (only fair values mentioned) are removed. In addition, private companies are excluded, because they do not have public accounting data. Consistent with Geczy et al. (1997), firms involved in mergers and acquisitions in the course of the five-year sample period are also removed from our sample. This reduces the sample to 350 firms, with 1630 total firm-year observations.

The Thomson Reuter's database and Google Finance are used as the main sources to obtain firm financial data. CEO managerial compensation information is obtained from the ExecuComp database and proxy statements. Of 350 companies, 10 did not have appropriate exercised and non-exercised options data in the ExecuComp database, reducing the sample to 340 firms and a total of 1498 firm-year observations. Data for the CEO's past job qualifications/experience and education are obtained from the proxy statements, 10Ks, and the website www.nndb.com. We could not find appropriate experience information for eight CEOs, bringing the total sample to 332 firms, with 1446 firm-year observations. The 332 firms of this study have made use of derivatives for COMM price fluctuations (*COMM* futures and swaps), IR risk (*IR* swaps and locks), and FX risk (*FX* forwards and futures). In 10-Ks, firms report separately derivatives used for hedging and those used for trading or speculation. We include only companies that use derivatives for hedging purposes.

Additionally, for some companies using *COMM* derivatives the 10-K information included the notional quantity of *COMM* hedging rather than a dollar amount. For example, firm A hedges 10 million BTU of natural gas and 45 million barrels of crude oil. In this case, to determine the quantity of derivatives, we multiply the total notional quantity hedged by the underlying price of the asset at that time. In addition, some companies mention the total number of contracts in their 10-K; so, to obtain the notional quantity, we multiply the number of contracts by the total contract unit from the CME website[7] and the underlying price at that time. In case of foreign currency forwards or futures, all values are converted to dollar values using the exchange rate at the time of the initiation of the contract.

Econometric methodology

We first perform a pooled OLS regression without the effect of CEO compensation variables (unconditional setting) to examine whether total derivatives use is associated with higher firm value as measured by Tobin's Q. We then replicate the regression analysis with *IR*, *FX*, and *COMM* derivatives and determine how each derivative instrument individually affects firm value. In accord with previous studies (Rossi Junior and Laham, 2008; Ahmed et al., 2010; Allayannis et al., 2012; and Marami and Dubois, 2013), in our regression analysis we control for time and industry effects. Since only firms with specific characteristics use derivatives, this may lead to self-selection bias. To resolve this problem, we deconstruct out main independent variable into its predicted and

[7] www.cme.com

excess components. This procedure was first applied by Shen and Zhang (2013) and partially addresses the endogeneity problem using a two-stage estimation procedure. In the first stage, we regress derivatives on firm factors known to affect hedging, such as R&D investments, leverage, and firm size, as in previous studies (Geczy et al. 1997; Graham and Rogers, 2002). In the second stage, the estimated excess derivative values from the first stage are used as independent variables to estimate their effect on firm value. This procedure of removing endogeneity has also been recently used by Caliskan and Doukas (2015). We also control for endogeneity using the 2SLS regression employing foreign currency debt and net operating loss carryforwards as instrument variables for the derivatives variable, similar to Hagelin et al. (2007).

After the unconditional test, we analyze the effect of derivatives on firm value in a conditional setting. This test is designed to condition the impact of hedging on firm value on CEO risk preferences, inferred from the characteristics of CEO compensation packages. To perform this conditional test, we split the CEO compensation variables by their median values and define a CEO risk preference variable as high if it is above the median. Consistent with the previous literature, we define risk-seeking CEOs as having a high vega and risk-averse CEOs as having high cash compensation, high share compensation, a high delta, and/or high inside debt compensation. We run five pooled OLS regressions, one for each of the risk preference variables: a high CEO compensation total vega (risk seeking), a high CEO compensation total delta (risk averse), high cash compensation (risk averse), high CEO share ownership (risk averse), and high

CEO inside debt (risk averse). We replicate this approach for total derivatives and for *IR, FX,* and *COMM* derivatives, separately.

VARIABLE DESCRIPTIONS

Dependent variables

The main dependent variable in our study is Tobin's Q, which we use as a proxy for a firm's market value. Consistent with Allayannis et al. (2012), we calculate Tobin's Q as the ratio of total assets minus the book value of shareholder equity plus the market value of equity to the book value of assets. In line with Allayannis and Weston (2001), we use the natural logarithm of Tobin's Q.

Independent variables

Main independent variable

We use the total notional quantity of derivatives used for hedging scaled by the total book value of assets (*Total Deriv/Assets*) as our main independent variable while we also examine how the individual derivatives—that is, *IR* derivatives (*IR/Assets*), *FX* derivatives (*FX/Assets*), and *COMM* derivatives (*COMM/Assets*)—affect firm value. Total derivatives consist of *COMM* derivatives (forwards and futures), *IR* derivatives (futures, forwards, and swaps), and *FX* currency derivatives (futures, forwards, and swaps). All the derivative data was hand-collected from the company's 10-K filings with the U.S. Securities and Exchange Commission for the five-year period 2008-2012.

CEO risk preference compensation-based variables

Calculating the vega and delta of option and stock portfolios

We calculate the vega and delta of the CEO stock option portfolios using the approach of Core and Guay (2002). Core and Guay separately calculate the option grants for the current year and previously granted options. For current-year option grants, we collect data for the CEOs' numbers of options from the ExecuComp database. The exercise price and time to maturity variables for current-year option grants are obtained from ExecuComp. Other variables required to estimate the vega and delta, such as stock price, volatility, interest rate, and dividend yield, are collected from the firm proxy statements and 10-K reports. Consistent with the previous literature, the Black-Scholes (1973) option valuation formula is used to calculate the option price (Knopf et al., 2002; Rogers, 2002). For previously granted options, ExecuComp has exercisable and unexercisable option values in their database but not the exercise price or time to maturity variables. Core and Guay's (2002) approach is used to approximate the time to maturity and exercise price. We calculate the vega and delta of the exercisable and un-exercisable options separately. A detailed explanation of the calculation of delta and vega is provided in Appendix B. The total vega of the option portfolio (*vega*) would be the vega of the current-year option portfolio and the vega of previous year's exercisable and unexercisable options. The total delta (*delta*) would be the sum of the delta of the current year options, the previous year's exercisable and un-exercisable options, and the sum of the delta of the stock portfolio. Finally, we multiply the vega and delta with the total number of options to obtain the vega and delta of the entire CEO option portfolio. The above-mentioned procedure is used to calculate the vega and delta for each of the five years of our sample (20082012).

After we calculate the CEO total delta and vega we obtain the other three compensation variables—CEO stock compensation (*Shares*), CEO cash compensation (*Cash*), and CEO inside debt compensation (*Indebt*) variables—from the ExecuComp database. We then split our sample into risk-averse and risk-seeking CEOs. CEOs are defined as risk seeking when their vega compensation exceeds the median vega value and as risk averse when their delta, share compensation, cash and inside debt compensation are above the corresponding median values. Next we test our hypotheses, mentioned above, to determine how each subsample affects the relation between derivatives hedging and firm value.

Control variables

The previous literature shows that firm size influences firm value (Peltzman, 1977; Mueller, 1987), but the results have been ambiguous (Jin and Jorion, 2006). In line with previous studies (Allayannis and Weston, 2001; Jin and Jorion, 2006; Ahmed et al., 2010; Allayannis et al., 2012; Pérez-González and Yun, 2013), we use the logarithm of total assets (*Log Assets*) to control for firm size and expect a positive relation between firm size and firm value, since larger firms hedge more with derivatives. To control for financial liquidity conditions, we use the quick ratio (*Quick ratio*) and expect a positive relation between the quick ratio and firm value (Rossi and Laham, 2008). To control for firm profitability, we use the lagged free cash flow scaled by assets (*Lag FCF/Assets*). Firms with high free cash flow should be more profitable in the long run and realize greater firm value (Jensen, 1986). We also use the dividend yield (*Dividend Yield*) as a control variable and its sign could be positive or negative. The greater the yield, the better the firm's future prospects, which should result in higher valuation (Rossi and Laham, 2008). On the other hand, if the firm has a higher yield, it is less likely to be constrained and will thus have a lower valuation (Allayannis and Weston, 2001). The relation between leverage and firm value is mixed in the literature. Lang et al. (1996) and Servaes (1996) state that highly levered firms have a higher Tobin's Q because they are most likely to undertake projects with a positive net present value, while Allayannis and Weston (2001) and Allayannis et al. (2012) find a negative relation between firm value and leverage. Thus, the impact of the leverage variable on firm value is positive or negative. We use the debt ratio (*Debt/Assets*) to proxy for firm leverage, as Bartram et al. (2011) and Ahmed et al. (2010). Following the previous literature (Allayannis and Weston, 2001; Rossi and Laham, 2008; Allayannis et al., 2012; Ahmed et al., 2010), we control for firm investment opportunities by using capital expenditures to assets (*Capex/Assets*) and R&D expenses to assets (*R&D/Assets*). We expect a positive relation between these two variables and firm value (Yermack, 1996). We also use foreign sales to total sales (*Foreign/Total Sales*) to control for geographic diversification. The relation between geographic diversification and firm value is conflicting. Doukas and Travlos (1988) show that geographic diversification through foreign mergers and acquisitions is beneficial to firm value, especially for firms without a prior foreign operating presence. Morck and Yeung (1992) and Bodnar and Weintrop

(1997) show that firms with high foreign sales have higher firm value, while Dennis et al. (2002) show that geographic diversification reduces firm value. We also use insider ownership (*Insider ownership*) to control for managerial entrenchment, which could cause a decrease in firm value, since block holders might work for themselves rather than for the shareholders (Faleye, 2007), and expect a negative relation between firm value and the insider ownership variable.

RESULTS

Univariate results

Table 1 reports the descriptive statistics of the variables used in the analysis. An average firm in our sample has a Tobin's Q of 2.87. This value is comparable to the average found in the literature. Bartram et al. (2011) report a Tobin's Q of 2.154, while Allayannis et al. (2012) and Allayannis and Weston (2001) report Tobin's Q values of 1.976 and 1.18, respectively. Looking at our main independent variable, we find that hedging amount to only 10% of the firm's total assets. This result is consistent with the evidence of Guay and Kothari (2003) stating that a firm's risk management program through derivatives hedging represents a small portion of the firm's total asset value. Looking at the derivatives separately, we see *IR* derivatives represent 5% of total assets, while the *FX* and *COMM* derivatives represent 4% and 0.8%, respectively. The mean value of total assets is high ($2.691 billion), as expected, since the firms in our sample are Fortune 500 companies. Looking at R&D expenditures scaled by total assets and capital expenses scaled by assets values, we find both to be lower (1.44% and 7.25%, respectively), suggesting that firms in our sample invest only a miniscule amount in R&D and capital expenses. Next, focusing on the CEO compensation variables, we observe that the mean CEO vega and delta of total CEO compensation are \$4.768 million and \$10.39 million, respectively, while the average CEO inside debt compensation is \$7.878 million. Average stock compensation is approximately \$533 million, suggesting that most of the CEOs' wealth in our sample is undiversified, with most of their equity tied to the fortunes of the firm.

Table 1. Summary statistics

This table reports the descriptive statistics of the variables used in the analysis. Inside debt is the total pension and deferred compensation of CEO compensation. Total derivatives are addition of total notional values of interest rate, commodity and currency contracts. Idiosyncratic risk is the standard deviation of stock returns. Total observations are 1446. For detailed description of variables see Appendices C and D.

Variable	**Mean**	**Std Dev**	**Min**	**Max**
Inside Debt (millions)	8.878	0.1994	0	232.6
Idiosyncratic Risk	0.02	0.0122	0	0.114
Total Cash Compensation (millions)	1.494	0.022	0	0.31
Total Option comp value (Current, exercisable & un-exercisable options-in millions)	2.33	11.39	0	218
Delta of CEO Compensation (millions)	10.39	180.9	0	5275
Vega of CEO Compensation (millions)	4.768	123.3	0	4195
CEO Age (in years)	56.18	6.255	37	85
Tobin's Q	2.87	17.43	-4.43	32.66
CEO Stock Compensation (millions)	543.99	0.7444	0	1179
Debt to Assets ratio	0.468	1.920	0	47.89
Total sales (billions)	2.01	3.089	0	26.50
Total assets (billions)	2.691	5.860	0	79.78
R&D Expense-scaled by Assets	0.0144	0.0361	0	0.399
Capital Expenditures- scaled by Assets	0.0725	0.245	0	4.588
Total Derivatives- scaled by Assets	0.100	0.18	0	0.7
Interest rate derivatives- scaled by Assets	0.05	0.001	0	0.636
FX derivatives- scaled by Assets	0.04	0.08	0	0.67
Commodity derivatives- scaled by Assets	0.008	0.05	0	0.56
Dividend Yield	0.0124	0.0182	0	0.146
Quick Ratio	0.946	0.819	0	7.568
Insider Ownership	0.0101	0.0627	0	1

Table 2 shows the total mean notional quantity of derivatives broken down by year. Total notional derivatives usage increased from 2008 to 2012, suggesting that firms have increased their hedging in recent years. A similar trend can be seen for hedging with *FX* and *IR* derivatives, but no such trend is observed for *COMM* derivatives. Total *IR* derivatives represent 50.7% of total derivatives, while *FX* derivatives correspond to 41.25% of total derivatives. This result further validates the inclusion of *IR* derivatives in our analysis, rather than just focusing on *FX* or *COMM* derivatives, as is the case in most previous studies (Beber and Fabbri, 2012; Tufano, 1996). The use of *IR* derivatives in the analysis of hedging provides an additional element of differentiation between this paper and previous studies. Thus, the inclusion of *IR* derivatives, a significant component of corporate hedging activity ignored in previous studies, recognizes the importance of IR risk arising from the exposure of firms to debt, motivating them to employ different debt derivative instruments such as *IR* swaps, forward swaps, and *IR* futures to hedge their exposure to IR risk.

Table 2: Notional of total derivatives broken down by year

This table reports the total mean notional quantity of derivatives broken down by year (from 2008 to 2012). The three types of derivatives included here are the interest rate derivatives, commodity derivatives and foreign exchange derivatives. All derivative values are in millions. In parentheses is the percentage of a specific derivative relative to total hedging.

Year	No. obs.	Interest rate (IR)	Commodity (COMM)	Foreign exchange (FX)	Total mean derivatives (In millions)	Derivatives/ Assets
2008	274	948.04 (58.68%)	104.62 (6.48%)	562.93 (34.84%)	1615.59	0.08
2009	293	1592.59 (51.3%)	93.68 (2.85%)	1415.22 (45.8%)	3101.49	0.1

2010	294	1702.71 (45.18)	183.75 (2.7%)	1614.23 (43.37%)	3500.7	0.11
2011	295	2186.68 (58.11%)	165.45 (9.39%)	1315.56 (32.5%)	3667.69	0.108
2012	290	1696.87 (40.23%)	399.45 (10.1%)	2087.66 (49.76%)	4183.98	0.109

Multivariate results

Unconditional setting

Table 3 reports the pooled OLS regression results of firm value on total derivatives hedging and individual derivatives. The first column shows the regression where the main independent variable is total derivatives scaled by assets (*Total Deriv/Assets*). The second column displays the regression where the independent variable is *IR* derivatives scaled by assets (*IR/Assets*). The third column reports the regression results where the main independent variable is the *FX* derivatives scaled by total assets (*FX/Assets*). The final column reports the regression results using *COMM* derivatives scaled by assets (*COMM/Assets*) as the main independent variable. Looking at the regression results in Model 1, we find, consistent with previous evidence that used non-US data (Ahmed et al., 2010; Bartram et al., 2011), that *Total Deriv/Assets* does not have a statistically significant effect on firm value. To further analyze the validity of this result, we examine the association between each type of derivative (*IR, FX,* and *COMM*) and firm value. These results, reported in Models 2 to 4 of Table 3, indicate that none of the individual derivatives is statistically significant in predicting firm value, suggesting that derivatives usage does not increase firm value.

Specifically, this evidence is inconsistent with the results of previous studies using just currency (*FX)* derivatives (Allayannis and Weston, 2001; Allayannis et al., 2012), which report a positive relation between firm value and *FX* hedging. However, our results are comparable with the findings of Tufano (1996) and Jin and Jorion (2006), who, using only *COMM* derivatives, did not find any relation between derivatives usage and firm value.

Table 3: Effect of Total Derivatives, and individual derivatives (IR, FX and COMM) on firm value (unconditional setting)

This table reports pooled OLS regression results of firm value (log (Tobin's q) on total derivatives hedging and individual derivatives (IR, FX and COMM). The first column shows the regression where the main independent variable is Total Derivatives/assets (Total Deriv/Assets). The second column shows the regression where the independent variable is Interest rate derivatives scaled by assets (IR/Assets). The third column shows regression where our main independent variable is Foreign exchange derivatives scaled by total assets (FX/Assets). The final column shows a regression where we use Commodity derivatives scaled by assets (COMM/Assets) as our main variable. The stars ***, **, and * indicate significance at the 1-percent, 5-percent, and 10-percent level, respectively. Standard errors are in parentheses.*** p<0.01, ** p<0.05, * p<0.1. For a detailed description of the variables, see Appendices C and D.

VARIABLES	(1) Model 1	(2) Model 2	(3) Model 3	(4) Model 4
Total Deriv/Assets	**0.0271**			
	(0.0359)			
IR/Assets		**0.0211**		
		(0.0369)		
FX/Assets			**-0.194**	
			(0.182)	
COMM/Assets				**-0.407**
				(0.453)
R&D/Assets	0.225	0.227	0.245	0.186
	(0.762)	(0.762)	(0.762)	(0.763)
Capex/Assets	0.0235	0.0235	0.0241	0.0234
	(0.0820)	(0.0821)	(0.0820)	(0.0820)
Debt/Assets	0.167***	0.167***	0.166***	0.166***
	(0.0205)	(0.0205)	(0.0205)	(0.0205)
Log (Assets)	-0.0775***	-0.0775***	-0.0779***	-0.0779***
	(0.0218)	(0.0218)	(0.0218)	(0.0218)
Div Yield	4.102***	4.110***	4.126***	4.123***
	(1.137)	(1.137)	(1.136)	(1.137)

Foreign/Total Sales	0.337***	0.336***	0.330***	0.333***
	(0.0823)	(0.0823)	(0.0824)	(0.0823)
Lag FCF/Asset	0.0783	0.0764	0.0790	0.0757
	(0.0843)	(0.0843)	(0.0842)	(0.0843)
Quick ratio	0.107***	0.108***	0.111***	0.109***
	(0.0284)	(0.0283)	(0.0285)	(0.0284)
Insider own	-0.310	-0.309	-0.307	-0.301
	(0.266)	(0.266)	(0.266)	(0.266)
Constant	1.459**	1.461**	1.498**	1.473**
	(0.585)	(0.585)	(0.586)	(0.585)
Industry	Y	Y	Y	Y
Year	Y	Y	Y	Y
Observations	1,439	1,439	1,439	1,439
R-squared	0.502	0.502	0.503	0.502

To ensure that our results are not sensitive to endogeneity, we control for endogeneity using Shen and Zhang's (2013) method, where the main variable is decomposed into its predicted and excess components. In the first stage, we regress derivatives on firm factors known to affect hedging, such as R&D investments, leverage, and firm size (Geczy et al., 1997; Graham and Rogers, 2002), as shown in Table 4. In the second stage, we use the excess values from the first stage and use them as independent variables to estimate their effect on firm value. Consistent with our previous findings, the results in Table 5 demonstrate that total and individual hedging derivatives have no significant impact on firm value, even when we control for endogeneity.

Turning to the control variables, we find the debt ratio *(Debt/Assets)* has a positive sign and is statistically significant at the 1% level, which is consistent with the previous literature (Lang and Stulz, 1996; Servaes, 1996; Allayannis et al., 2012), suggesting that firms in financial distress are more likely to undertake riskier projects resulting in higher firm value, while the sign of the quick ratio

(*Quick ratio*) is positive and statistically significant, as expected, and in line with the previous literature (Nance et al., 1993). Foreign sales (*Foreign/Total Sales*) are positive and statistically significant at the 1% level, indicating that firms with high levels of international sales are associated with higher valuations (Morck and Yeung, 1992). To control for firm profitability, we use the lagged free cash flow scaled by assets (*Lag FCF/Assets*). This profitability measure is not statistically significant, implying that firm free cash flows have no effect on firm value. The total assets variable (*Log Assets*) is significant, with a negative sign, implying that larger firms have lower value compared to smaller firms. This evidence is consistent with the results of Warner (1977) and O'Brien and Bhushan (1990). The dividend yield (*Dividend Yield*) variable is positive and statistically significant at the 1% level, indicating that firms that pay more dividends have higher valuations.

In sum, the evidence thus far shows that none of our two (*HI* and *H2*) foregoing hypotheses gain significant support in terms of predicting firm value in an unconditional setting for any of the individual hedging derivatives or for total derivatives hedging. Our results are robust to endogeneity tests using the Shen and Zhang (2013) and 2SLS methods.[8]

Table 4: Addressing for Endogeneity

This table reports regressions results based on the Shen and Zhang (2013) method to control for endogeneity and sample-selection bias. The dependent variables are Total Deriv/Assets, IR/assets and FX/assets. The independent variables are taken from Geczy et al. (1997), Nance et al. (1993) and Knopf et al. (2002) which are known to affect hedging decisions. The stars ***, **, and * indicate significance at the 1-percent, 5percent, and 10-percent level, respectively. Standard errors are in parentheses. *** p<0.01, ** p<0.05, * p<0.1. For a detailed description of the

[8] Our 2SLS results are available upon request.

variables, see Appendices C and D.

VARIABLES	(1) Total Deriv/Assets	(2) IR/Assets	(3) FX/Assets	(4) COMM/Assets
R&D/Assets	-0.0680	-0.253	0.146	-0.0779
	(0.602)	(0.586)	(0.119)	(0.0477)
Debt/Assets	0.00340	0.00562	-0.00167	-0.000762
	(0.0160)	(0.0156)	(0.00317)	(0.00127)
Capex/Assets	1.56e-05	-0.00272	0.00396	1.74e-05
	(0.0643)	(0.0625)	(0.0127)	(0.00510)
Foreign/Total Sales	-0.0230	-0.0139	-0.0101	-0.00275
	(0.0604)	(0.0588)	(0.0119)	(0.00479)
Log (Assets)	-0.00480	-0.00106	-0.00300	-0.00121
	(0.0171)	(0.0166)	(0.00337)	(0.00135)
Div yield	1.070	0.882	-0.000425	-0.00728
	(0.887)	(0.863)	(0.175)	(0.0703)
NOLs/Assets	0.0869	0.206	-0.0857	-0.0148
	(0.313)	(0.304)	(0.0618)	(0.0248)
Constant	0.277	0.154	0.212**	0.0290
	(0.458)	(0.446)	(0.0905)	(0.0363)
Industry	Y	Y	Y	Y
Year	Y	Y	Y	Y
Observations	1,439	1,439	1,439	1,439
R-squared	0.216	0.213	0.353	0.409

Table 5: Effect of total Derivatives & IR, FX and COMM derivatives on firm value (Unconditional setting): Addressing for Endogeneity

This table reports pooled OLS regression results of firm value (log (Tobin's q) on total derivatives hedging and individual derivatives (IR, FX and COMM) after controlling for endogeneity using the Shen and Zhang (2013) method. The first column shows the regression where the main independent variable is Total Derivatives/assets (Total Deriv/Assets). The second column shows the regression where the independent variable is Interest rate derivatives scaled by assets (IR/Assets). The third column shows regression where the main independent variable is Foreign exchange derivatives scaled by total assets (FX/Assets). The final column shows a regression where we use Commodity derivatives scaled by assets (COMM/Assets) as our main variable. The stars ***, **, and * indicate significance at the 1-percent, 5-percent, and 10-percent level, respectively. Standard errors are in parentheses. *** p<0.01, ** p<0.05, * p<0.1. For a detailed description of the variables, see Appendices C and D.

VARIABLES	(1) Model 1	(2) Model 2	(3) Model 3	(4) Model 4

Excess_Deriv	**0.0278** **(0.0359)**			
IR_Excess		**0.0227** **(0.0369)**		
FX_Excess			**-0.210** **(0.182)**	
COMM_Excess				**-0.424** **(0.453)**
R&D/Assets	0.224 (0.762)	0.222 (0.762)	0.221 (0.762)	0.220 (0.762)
Capex/Assets	0.0234 (0.0820)	0.0234 (0.0821)	0.0232 (0.0820)	0.0234 (0.0820)
Debt/Assets	0.167*** (0.0205)	0.167*** (0.0205)	0.167*** (0.0205)	0.167*** (0.0205)
Log (Assets)	-0.0777*** (0.0218)	-0.0776*** (0.0218)	-0.0773*** (0.0218)	-0.0774*** (0.0218)
Div yield	4.131*** (1.137)	4.128*** (1.137)	4.126*** (1.136)	4.126*** (1.136)
Foreign/Total Sales	0.337*** (0.0823)	0.336*** (0.0823)	0.332*** (0.0823)	0.334*** (0.0822)
Lag FCF/Asset	0.0782 (0.0843)	0.0763 (0.0843)	0.0790 (0.0842)	0.0756 (0.0843)
Quick Ratio	0.107*** (0.0284)	0.107*** (0.0283)	0.111*** (0.0285)	0.109*** (0.0284)
Insider own	-0.310 (0.266)	-0.309 (0.266)	-0.307 (0.266)	-0.301 (0.266)
Constant	1.467** (0.585)	1.465** (0.585)	1.459** (0.585)	1.461** (0.585)
Industry	Y	Y	Y	Y
Year	Y	Y	Y	Y
Observations	1,439	1,439	1,439	1,439
R-squared	0.502	0.502	0.503	0.502

Conditional setting: CEO risk preferences

Next, we estimate the effect of derivatives on firm value conditional on CEO risk preferences. Consistent with the previous literature (Mian, 1996; Tufano, 1996; Knopf et al., 2002; Beber and Fabbri, 2012) and as discussed earlier, we define risk-seeking CEOs as having a high vega compensation and risk-averse CEOs as having a high delta, high share compensation, high cash and high inside debt compensation. We define CEO compensation as high when the compensation measures exceed their median values. As before, we first look at total derivatives and then analyze the effects of *IR, FX*, and *COMM* derivatives separately on firm value. In Table 6, we report the effect of total derivatives hedging on firm value conditional on the five CEO risk preference measures. The results of Model 1 reveal that derivatives hedging by risk-seeking CEOs, measured by high vega compensation, does not affect firm value. Similarly, as shown in Models 2 to 5, firm value does not appear to be influenced by the hedging of risk-averse CEOs, as measured by high delta, high cash compensation, high share compensation, and high inside debt compensation, respectively. This evidence supports *H3*, which predicts that market value sensitivities to derivatives hedging for firms run by risk-averse or risk-seeking CEOs are unlikely to differ much. To ensure that our results are not endogenous, as before, we control for endogeneity, as Shen and Zhang (2013), and find that our results reported in Table 6, as shown in Table 7, remain unchanged. We also control for endogeneity using the 2SLS method and our main results still hold. [9] Collectively, the above results suggest that CEO compensation contracts designed to encourage risk taking for the sake of value creation do not work. Our results hold when we control for endogeneity using Shen and Zhang's (2013) method and 2SLS.

Table 6: Effect of total derivatives on firm value conditional on CEO risk preferences

[9] Results available upon request.

This table reports pooled OLS regression results where the dependent variable is log (Tobin's q) and main independent variable is Total derivatives/Assets. Each of the regression below is split up by the median value of each the five CEO compensation variables (Total CEO vega, Total delta, Total Cash compensation, CEO Share Compensation and CEO Inside Debt). All variables greater than the median value are termed "high". The risk preference variables are then divided into risk seeking CEOs proxied by high vega, and risk-averse CEOs proxied by high delta, high inside debt compensation, high cash compensation and high share compensation.
The stars ***, **, and * indicate significance at the 1-percent, 5-percent, and 10-percent level, respectively. Standard errors in parentheses. For a detailed description of the variables, see Appendices C and D.

VARIABLES	(1) Risk seeking (High vega)	(2) Risk averse (High delta)	(3) Risk averse (High Cash)	(4) Risk averse (High Shares)	(5) Risk averse (High InDebt)
Deriv/Assets	**0.0296**	**0.0389**	**0.0266**	**0.0428**	**0.0206**
	(0.0463)	**(0.0381)**	**(0.0308)**	**(0.0388)**	**(0.0401)**
R&D/Assets	-2.482**	-2.831**	-1.989**	-3.543***	1.077
	(1.260)	(1.183)	(0.994)	(1.198)	(1.185)
Capex/Assets	0.432**	-0.152	-0.137	-0.140	-0.0450
	(0.187)	(0.0956)	(0.0903)	(0.0956)	(0.0960)
Debt/Assets	0.124***	0.202***	0.142***	0.184***	0.470***
	(0.0316)	(0.0254)	(0.0215)	(0.0248)	(0.0472)
Log (Assets)	-0.12***	-0.12***	-0.13***	-0.124***	0.0339
	(0.0364)	(0.0355)	(0.0254)	(0.0332)	(0.0321)
Div yield	4.182**	4.948***	4.347***	4.246**	3.546**
	(1.891)	(1.800)	(1.332)	(1.767)	(1.676)
Foreign Sales	0.116	0.0841	0.298***	0.0179	-0.0160
	(0.123)	(0.124)	(0.0996)	(0.126)	(0.129)
Lag FCF	0.833**	1.317***	0.259	1.051***	-0.00275
	(0.367)	(0.344)	(0.189)	(0.273)	(0.101)
Quick ratio	0.202***	0.251***	0.0717**	0.219***	0.0930**
	(0.0422)	(0.0393)	(0.0360)	(0.0424)	(0.0467)
Insider own	-0.240	-0.207	1.301**	0.255	0.243
	(0.324)	(0.289)	(0.589)	(0.371)	(0.402)
Constant	3.289***	3.088***	2.906***	3.115***	-0.515
	(0.923)	(0.882)	(0.629)	(0.826)	(0.774)
Industry	Y	Y	Y	Y	Y
Year	Y	Y	Y	Y	Y
Observations	718	718	715	718	806
R-squared	0.553	0.542	0.658	0.542	0.530

Table 7: Effect of total derivatives on firm value conditional on CEO risk preferences after controlling for endogeneity.

This table reports pooled OLS regression results where the dependent variable is log (Tobin's Q) and main independent variable is Excess Derivatives/Assets variable. Each of the regression below is split up by the median value of each the five CEO compensation variables (Total CEO vega, Total delta, Total Cash compensation, CEO Share Compensation and CEO Inside Debt). All variables greater than the median value are termed "high". The risk preference variables are then divided into risk seeking CEOs proxied by high vega, and risk-averse CEOs proxied by high delta, high inside debt compensation, high cash compensation and high share compensation. The stars ***, **, and * indicate significance at the 1 percent, 5-percent, and 10-percent level, respectively. Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1. For a detailed description of the variables, see Appendices C, and D.

VARIABLES	(1) Risk seeking (High vega)	(2) Risk averse (High delta)	(3) Risk averse (High Cash)	(4) Risk averse (High Shares)	(5) Risk averse (High InDebt)
Excess_Deriv	0.0302	0.0392	0.0269	0.0430	0.0214
	(0.0463)	(0.0381)	(0.0308)	(0.0388)	(0.0401)
R&D/Assets	-2.484**	-2.834**	-1.991**	-3.546***	1.076
	(1.260)	(1.183)	(0.994)	(1.198)	(1.185)
Capex/Assets	0.432**	-0.152	-0.137	-0.140	-0.0450
	(0.187)	(0.0956)	(0.0903)	(0.0956)	(0.0960)
Debt/Assets	0.124***	0.203***	0.142***	0.185***	0.470***
	(0.0316)	(0.0254)	(0.0215)	(0.0248)	(0.0472)
Log (Assets)	-0.13***	-0.13***	-0.14***	-0.124***	0.0338
	(0.0364)	(0.0355)	(0.0254)	(0.0332)	(0.0321)
Div yield	4.213**	4.990***	4.375***	4.292**	3.567**
	(1.889)	(1.799)	(1.331)	(1.766)	(1.674)
Foreign Sales	0.115	0.0833	0.298***	0.0170	-0.0163
	(0.123)	(0.124)	(0.0995)	(0.126)	(0.129)
Lag FCF	0.833**	1.317***	0.259	1.051***	-0.00276
	(0.367)	(0.344)	(0.189)	(0.273)	(0.101)
Quick ratio	0.202***	0.251***	0.0717**	0.219***	0.0930**
	(0.0422)	(0.0393)	(0.0360)	(0.0424)	(0.0467)
Insider own	-0.240	-0.207	1.301**	0.255	0.243
	(0.324)	(0.289)	(0.589)	(0.371)	(0.402)
Constant	3.297***	3.097***	2.914***	3.125***	-0.507
	(0.923)	(0.881)	(0.629)	(0.826)	(0.774)
Year	Y	Y	Y	Y	Y
Industry	Y	Y	Y	Y	Y
Observations	718	718	715	718	806
R-squared	0.553	0.542	0.658	0.542	0.530

Most importantly, as shown in Table 8, we also find that the hedging intensity, measured through total derivatives scaled by firm assets, is similar for both risk-seeking and risk-averse CEOs. Risk-seeking CEOs, proxied by a high vega, have a hedging intensity of 0.136, while the average of the four risk-averse CEO compensation measures shows that risk-averse CEOs have a hedging intensity of 0.130. Guay and Kothari (2003), using 1998 hedging data for a sample of 234 large nonfinancial firms, find similar evidence without investigating hedging intensity differences between risk-averse and risk-seeking CEOs. This pattern of our findings provides new evidence in support of the view that the nature of compensation contracts and alternative measures used to capture CEO attitudes toward risk do not have a bearing on firm value, as has been argued in previous studies. The comparable hedging intensity between risk-averse and risk-seeking CEOs suggests that CEOs view hedging more as an insurance policy than as a value-increasing decision.

This pattern contradicts the previously held notion that hedging affects firm value and varies with CEO risk preferences. This result has never been documented in the literature and is one of the novel findings of this paper.

Table 8: Hedging intensity of firms managed by risk-seeking and risk-averse CEOs.

This table reports the Hedging Intensity of firms managed by risk-averse and risk-seeking firms. Hedging intensity is measured based on the Total Derivatives/Assets ratio. The risk preference variables are then divided into risk-seeking CEOs proxied by high CEO Total vega, and risk-averse CEOs proxied by high Total CEO delta, Total Cash compensation, CEO Share Compensation and CEO Inside Debt compensation.

	High vega CEOs (risk seeking)	High delta CEOs (risk averse)	High Cash CEOs (risk averse)	High Shares CEOs (risk averse)	High Inside Debt CEOs (risk averse)
CEO Hedging intensity	0.136	0.133	0.130	0.125	0.115

Market value sensitivities of firms' derivatives portfolios

Next, we examine the market value sensitivities of firms' derivatives portfolios by estimating the total sensitivities for an average firm in our sample based on extreme (three standard-deviation) changes in the prices of the underlying asset—that is, *FX* rates (US dollar index), *IR*s (T-bills), and *COMM*s (Producer Price Index, or PPI, for fuel)—as Guay and Kothari (2003). Appendix A describes this method in detail. As can be seen from Table 9, Panel A, a three-standard-deviation change in the exchange rate increases an average firm's market value by $302 million. Similarly, looking at firms' *IR* exposure, we find that a three-standard-deviation change in T-bills increases the IR derivatives portfolio by $3.3 billion. Finally, we find that the average firm's market-based sensitivity to a three standard-deviation change in *COMM* prices is $148 million. The sum of these values in response to a three-standard-deviation (extreme) change in the total derivatives portfolio value suggests that an average firm's market value increases by $3.7 billion. This value is modest compared to the average value of total assets (13%) and total sales (19%) of the average firm in our sample. These results are consistent with the one-year (1998) hedging findings of Guay and Kothari (2003).

Next, we examine changes in the sensitivities of the market value of derivatives for firms run by risk-averse and risk-seeking CEOs, proxied by high vega, separately. Panel B of Table 9 shows that an average firm's market-based exposure to a three-standard deviation change in *FX* rates (US dollar index), *IR*s (T-bills), and *COMM*s (PPI for fuel) for firms run by risk-seeking CEOs increases the value of the derivatives portfolio by $357 million, $4.01 billion, and $179 million, respectively. Combining the three derivatives portfolios, we observe that, for a three-standard-deviation change in the value of underlying assets, the total derivatives portfolio of firms run by risk-seeking CEOs increases firm value by $4.57 billion. This number is modest relative to the total assets (12.8%) and total sales (21%) of the average firm in the sample.

Derivatives' market value sensitivities for firms run by risk-averse CEOs

The market value sensitivities of the total derivatives portfolios of firms managed by risk-averse CEOs, proxied by a high delta, high cash compensation, high share compensation, and high inside debt compensation, are reported next to those for risk seeking CEOs in Panel B of Table 9. When we average the values for the four risk-aversion measures, a three-standard-deviation change in T-bills increases the *IR* derivatives portfolio by an average of $4.7 billion; for the *FX* derivatives, a three-standard-deviation change in the dollar index increases firm value by $394 million and a three-standard deviation in the PPI of fuel (COMM index) increases the *COMM* derivatives portfolio by $130 million. In aggregate, total derivatives usage by risk-averse CEOs increases firm value by $5.21 billion, or 13.2%, in terms of total assets and by 20.5% in terms of total sales. In sum, the total derivatives portfolio of firms run by risk-seeking and risk-averse CEOs increases firm value by only \$4.57 billion and \$5.21 billion, respectively, modest quantities relative to total assets and sales.

These results suggest that the risk management policies of risk-averse and risk seeking CEOs are very similar and have only a small impact on firm value. The main implication of these findings, in combination with the similar hedging intensities of risk averse and risk-seeking CEOs (0.12 and 0.11, respectively), is that hedging is not a value maximizing strategy. Our findings also suggest that hedging policies do not vary significantly with CEO risk preferences and compensation packages designed to motivate risk seeking behavior (i.e., engage in less hedging) do not seem to alter the inherent risk averse attitude of CEOs. Overall, our multi-year evidence is inconsistent with the conventional belief and *H4* and *H5* predicting that firms run by risk-averse (risk-seeking) CEOs are expected to hedge more (less) with total (individual) derivatives, resulting in greater (lower) firm value.

Table 9: Market value sensitivities of firms' derivatives portfolios at the end of 2008

Panel A: Reports market value (MV) sensitivities for firms' total derivatives portfolios at end of year 2008. Market value sensitivity is defined as the change in the annual market value resulting from each derivative security in the portfolio for a three-standard deviation annual change in the price of the underlying asset (i.e., change in exchange rates, interest rates, or commodity prices) and in aggregate. For a detailed explanation of the procedure first used by Guay and Kothari (2003), see Appendix A.)

Sensitivity of Derivatives (by type)	**Change in firm value**
FX derivatives	\$302 million
IR derivatives	\$3.3 billion
COMM derivatives	\$148 million
Total derivatives	\$3.7 billion
Firm total assets (average)	\$29.7 billion

Firm total sales (average)	$19.9 billion
Sensitivity of derivatives MV to total assets	**13%**
Sensitivity of derivatives MV to total sales	**19%**

Panel B: Reports market value (MV) sensitivities for firms' derivatives portfolio at end of year 2008. Market value sensitivity is defined as the change in the annual market value resulting from each derivative security in the portfolio for a three-standard deviation annual change in the price of the underlying asset (i.e., change in exchange rates, interest rates, or commodity prices) and in aggregate. For a detailed explanation of the procedure first used by Guay and Kothari (2003), see Appendix A.)

Sensitivity Variables (in millions $)	(1) Risk seeking (High vega)	(2) Risk averse (High delta)	(3) Risk averse (High Cash)	(4) Risk averse (High Shares)	(5) Risk averse (High InDebt)
FX Derivatives	357	336	441	378	420
IR derivatives	4011	4400	5157	4600	4500
COMM derivatives	179	201	140	200	89
Total Derivatives	4547	4937	5738	5178	5009
Total Assets (average)	35600	37600	41500	3900	39600
Total Sales (average)	21900	23400	26000	23800	27700
Sensitivity of derivatives MV to total assets	**12.8%**	**13.1%**	**13.8%**	**13.3%**	**12.6%**
Sensitivity of derivatives MV to total sales	**21%**	**21%**	**23%**	**22%**	**19%**

Next, we examine the individual firm valuation effects of derivative instruments, starting with *IR* derivatives conditional on CEO risk preferences, and we report the results in Table 10. First, consistent with the previously reported results, Model 1 shows that hedging through *IR* derivatives by risk-seeking CEOs, as measured by high vega compensation, does not affect firm value. In Models 2 to 5, we also observe a similar pattern for risk-averse CEOs, measured by a high delta, high cash compensation, high share compensation, and high inside debt compensation, respectively. Hedging by risk-averse CEOs does not affect firm value. As before, these results remain unchanged when we control for endogeneity using Shen and Zhang's (2013) procedure and the 2SLS instrumental variable approach.[10]

Collectively, the results obtained using *IR* derivatives are similar to those documented for total derivatives. We find *IR* hedging carried out by both risk-seeking and risk-averse CEOs does not affect firm value. Combining this result with the hedging intensity result, reported in Table 8, we can infer that derivatives hedging does not matter to firm value. Thus, it can be safely argued that CEO compensation contracts intended to motivate greater risk tolerance (less hedging) to increase firm value through derivatives hedging does not work.

Table 10: The Effect of Interest rate derivatives (IR) on firm value conditional on CEO risk preferences

This table reports pooled OLS regression results where the dependent variable is log (Tobin's q) and main independent variable is Interest rate derivatives/assets (**IR/Assets**). Each of the regression below is split up by the median value of each the five CEO compensation variables (Total CEO vega, Total delta, Total Cash compensation, CEO Share Compensation and CEO Inside Debt). All variables greater than the median value is termed "high" The risk preference variables are then divided into risk seeking CEOs proxied by high vega, and risk-averse CEOs proxied by high delta, high inside debt compensation, high cash compensation and high share compensation.
The stars ***, **, and * indicate significance at the 1-percent, 5-percent, and 10-percent level, respectively. Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1. For a detailed description of the variables, see Appendices C and D.

VARIABLES	(1) Risk seeking (High vega)	(2) Risk averse (High delta)	(3) Risk averse (High Cash)	(4) Risk averse (High Shares)	(5) Risk averse (High InDebt)

[10] Results available upon request.

IR/Assets	**0.0150**	**0.0341**	**0.0264**	**0.0408**	**0.0151**
	(0.0469)	**(0.0387)**	**(0.0309)**	**(0.0393)**	**(0.0405)**
R&D/Assets	-2.478**	-2.833**	-1.988**	-3.54***	1.079
	(1.260)	(1.183)	(0.994)	(1.199)	(1.185)
Capex/Assets	0.432**	-0.152	-0.137	-0.140	-0.0448
	(0.187)	(0.0957)	(0.0903)	(0.0957)	(0.0961)
Debt/Assets	0.124***	0.202***	0.141***	0.184***	0.470***
	(0.0316)	(0.0254)	(0.0215)	(0.0248)	(0.0472)
Log (Assets)	-0.13***	-0.13***	-0.14***	-0.12***	0.0339
	(0.0364)	(0.0355)	(0.0254)	(0.0332)	(0.0321)
Div yield	4.213**	4.958***	4.354***	4.253**	3.561**
	(1.892)	(1.800)	(1.332)	(1.767)	(1.675)
Foreign Sales	0.115	0.0829	0.298***	0.0164	-0.0178
	(0.123)	(0.124)	(0.0995)	(0.126)	(0.129)
Lag FCF	0.833**	1.319***	0.260	1.051***	-0.00423
	(0.367)	(0.344)	(0.189)	(0.273)	(0.101)
Quick ratio	0.202***	0.252***	0.0720**	0.220***	0.0936**
	(0.0422)	(0.0393)	(0.0360)	(0.0424)	(0.0467)
Insider own	-0.238	-0.206	1.300**	0.258	0.245
	(0.324)	(0.289)	(0.589)	(0.371)	(0.402)
Constant	3.289***	3.093***	2.905***	3.116***	-0.511
	(0.923)	(0.882)	(0.629)	(0.826)	(0.774)
Observations	718	718	715	718	806
R-squared	0.552	0.542	0.658	0.542	0.530

Next, we replicate the previous analysis by focusing on the valuation effect of *FX* derivatives conditional on CEO risk preferences. The results, shown in Table 11, demonstrate a similar pattern to that obtained for both total derivatives and IR derivatives hedging. As before, these results are robust to endogeneity tests using Shen and Zhang's (2013) method and 2SLS.[11]

Table 11: The Effect of Foreign Exchange derivatives (FX) on firm value conditional on CEO risk preferences.

This table reports pooled OLS regression results where the dependent variable is log (Tobin's Q) and main independent variable is Foreign Exchange derivatives/Assets (**FX/Assets**). Each of the

[11] Results available upon request.

regression below is split up by the median value of each the five CEO compensation variables (Total CEO vega, Total delta, Total Cash compensation, CEO Share Compensation and CEO Inside Debt). All variables greater than the median value is termed "high." The risk preference variables are then divided into risk seeking CEOs proxied by high-vega, and risk-averse CEOs proxied by high delta, high inside debt compensation, high cash compensation and high share compensation.

The stars ***, **, and * indicate significance at the 1-percent, 5-percent, and 10-percent level, respectively. Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1. For a detailed description of the variables, see Appendices C and D.

VARIABLES	(1) Risk seeking (High vega)	(2) Risk averse (High delta)	(3) Risk averse (High Cash)	(4) Risk averse (High Shares)	(5) Risk averse (High InDebt)
FX/Assets	**-0.0176**	**-0.239**	**0.0238**	**-0.521***	**-0.290**
	(0.281)	**(0.264)**	**(0.294)**	**(0.288)**	**(0.286)**
R&D/Assets	-2.472*	-2.802**	-2.002**	-3.45***	1.120
	(1.261)	(1.184)	(0.995)	(1.197)	(1.185)
Capex/Assets	0.433**	-0.153	-0.138	-0.142	-0.0427
	(0.187)	(0.0957)	(0.0904)	(0.0955)	(0.0960)
Debt/Assets	0.124***	0.202***	0.142***	0.184***	0.469***
	(0.0316)	(0.0254)	(0.0216)	(0.0248)	(0.0472)
Log (Assets)	-0.13***	-0.13***	-0.14***	-0.12***	0.0343
	(0.0365)	(0.0355)	(0.0254)	(0.0331)	(0.0320)
Div yield	4.248**	5.055***	4.407***	4.390**	3.671**
	(1.889)	(1.799)	(1.332)	(1.763)	(1.675)
Foreign Sales	0.114	0.0752	0.296***	-0.00101	-0.0359
	(0.124)	(0.124)	(0.0996)	(0.126)	(0.130)
Lag FCF	0.834**	1.338***	0.259	1.067***	-0.00280
	(0.368)	(0.345)	(0.190)	(0.272)	(0.101)
Quick ratio	0.203***	0.257***	0.0726**	0.231***	0.0985**
	(0.0424)	(0.0395)	(0.0362)	(0.0426)	(0.0469)
Insider own	-0.238	-0.201	1.304**	0.308	0.270
	(0.324)	(0.289)	(0.589)	(0.371)	(0.403)
Constant	3.289***	3.095***	2.912***	3.087***	-0.460
	(0.925)	(0.882)	(0.630)	(0.825)	(0.775)
Industry	Y	Y	Y	Y	Y
Year	Y	Y	Y	Y	Y
Observations	718	718	715	718	806
R-squared	0.552	0.542	0.658	0.544	0.531

Finally, we also examine the valuation effect of *COMM* derivatives conditional on the same CEO risk preference measures and we report the results in Table 12.

Consistent with previous findings, we document that *COMM* derivatives hedging does not matter to firm value, regardless of the risk preference measures used to capture CEO risk-averse or risk-seeking behavior.

In sum, our results point out that both unconditional derivatives hedging (total and separately, by derivative instrument) and derivatives hedging conditional on CEO risk preferences do not affect firm value. Thus, the evidence does not support the predictions of *H4* or *H5*. Jointly, our evidence suggests that hedging acts as insurance rather than as a value-increasing strategy, regardless of CEO risk preferences. Interestingly, our evidence also points out that CEO compensation packages structured to tilt managers' risk preferences in favor of risk-seeking behavior fail to motivate less hedging. Put differently, compensation packages designed to motivate risk-seeking (less hedging) behavior do not seem to change the inherent risk-averse attitude of CEOs, as demonstrated by the similarity in the hedging intensities of risk-averse and risk-seeking CEOs.

Table 12: The Effect of Commodity derivatives (COMM) on firm value conditional on CEO risk preferences

This table reports pooled OLS regression results where the dependent variable is log (Tobin's Q) and main independent variable is Commodity derivatives/Assets (**COMM/Assets**). Each of the regression below is split up by the median value of each the five CEO compensation variables (Total CEO vega, Total delta, Total Cash compensation, CEO Share Compensation and CEO Inside Debt). All variables greater than the median value is termed "high." The risk preference variables are then divided into risk seeking CEOs proxied by high vega, and risk-averse CEOs proxied by high delta, high inside debt compensation, high cash compensation and high share compensation.
The stars ***, **, and * indicate significance at the 1-percent, 5-percent, and 10-percent level, respectively. Standard errors in parentheses. *** $p<0.01$, ** $p<0.05$, * $p<0.1$. For a detailed description of the variables, see Appendices C and D.

	(1) Risk	(2) Risk	(3) Risk	(4) Risk	(5) Risk

VARIABLES	seeking (High vega)	averse (High delta)	averse (High Cash)	averse (High Shares)	averse (High InDebt)
COMM/Assets	**-0.696**	**-0.634**	**0.147**	**-0.232**	**-2.212***
	(0.648)	**(0.641)**	**(0.723)**	**(0.673)**	**(1.277)**
R&D/Assets	-2.472*	-2.945**	-1.984**	-3.58***	1.084
	(1.261)	(1.188)	(0.997)	(1.202)	(1.182)
Capex/Assets	0.433**	-0.156	-0.138	-0.141	-0.0465
	(0.187)	(0.0957)	(0.0904)	(0.0957)	(0.0959)
Debt/Assets	0.124***	0.202***	0.142***	0.184***	0.469***
	(0.0316)	(0.0254)	(0.0216)	(0.0249)	(0.0471)
Log (Assets)	-0.13***	-0.13***	-0.14***	-0.13***	0.0325
	(0.0365)	(0.0356)	(0.0254)	(0.0333)	(0.0320)
Div yield	4.248**	4.950***	4.410***	4.302**	3.505**
	(1.889)	(1.800)	(1.331)	(1.768)	(1.671)
Foreign Sales	0.114	0.0846	0.297***	0.0127	-0.0206
	(0.124)	(0.124)	(0.0996)	(0.126)	(0.129)
Lag FCF	0.834**	1.297***	0.260	1.045***	-0.00286
	(0.368)	(0.344)	(0.189)	(0.273)	(0.101)
Quick ratio	0.203***	0.254***	0.0730**	0.222***	0.0949**
	(0.0424)	(0.0393)	(0.0360)	(0.0424)	(0.0466)
Insider own	-0.238	-0.193	1.304**	0.260	0.239
	(0.324)	(0.289)	(0.589)	(0.372)	(0.402)
Constant	3.289***	3.208***	2.910***	3.155***	-0.475
	(0.925)	(0.888)	(0.630)	(0.832)	(0.772)
Industry	Y	Y	Y	Y	Y
Year	Y	Y	Y	Y	Y
Observations	718	718	715	718	806
R-squared	0.552	0.542	0.658	0.541	0.532

CONCLUSION

This study examines the impact of hedging on firm value and the hedging intensities of firms run by CEOs with different risk preferences. Using hedging data from a hand-collected sample of derivatives for Fortune 500 firms over a five-year period, we first examine the impact of derivatives usage on firm value and find that neither total derivatives hedging nor individual (IR, FX, and COMM) derivatives hedging affects firm value. Unlike previous studies, we find that the total derivatives portfolio increases firm value modesty compared to a firm's overall risk exposure and hedging intensities of risk-seeking and risk-averse CEOs to be strikingly similar.

Specifically, we find that the total derivatives portfolio increases firm value by only \$3.7 billion. This is a modest increase compared to the total assets (13%) and total sales (19%) of the average firm in our multi-year sample. This result is inconsistent with the previous literature, which has mainly used only *FX* or *COMM* derivatives data. Furthermore, in contrast with the previous literature, when we re-examine the relation between hedging and firm value conditional on CEO risk preferences, we also find that derivatives hedging does not have a significant impact on firm value for either risk-seeking or risk-averse CEOs. Specifically, the evidence reveals that the value gains from using derivatives are minimal for both types of CEOs (approximately 13% relative to total assets and 21% relative to total sales for the average Fortune 500 firm). This result suggests that firm value creation through the use of corporate derivatives is minimal compared to a firm's overall risk exposure. We also find that, when the average firm experiences an extreme (three-standard-deviation) change in interest rates, commodity prices, or foreign exchange rates, its derivatives portfolio creates only modest gains, regardless of CEO risk preferences.

Finally, a more interesting finding of our investigation is that risk-seeking and risk-averse CEOs exhibit the same magnitude of hedging intensity (around 0.10–0.11), as measured through total derivatives scaled by assets, a finding that has not been recorded in the previous literature. Contrary to earlier studies, these results demonstrate that CEO risk preferences fail to alter CEOs' inherent risk aversion. This suggests that CEO compensation contracts designed to motivate risk taking (hedge less), do not seem to work as expected. The hedging intensity similarity, documented in the data for the first time, between risk-seeking and risk-averse CEOs in conjunction with the value irrelevance of hedging indicate that derivatives usage is viewed by corporate managers as an insurance policy, as suggested by Stulz (2013), rather than as a value-maximizing decision.

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APPENDIX A: Calculation of the market value sensitivities of the total derivatives portfolio for extreme (three-standard-deviation) changes in the underlying asset, as noted by Guay and Kothari (2003)

FX derivatives. For FX derivatives, an extreme change is defined as a 21.33% change in the currency exchange rate. A 21.33% change equals three times the average historical standard deviation of annualized percentage changes in the US dollar exchange rate for the 10 most heavily weighted currencies in the Federal

Reserve's Nominal Major Currencies Dollar Index. The annualized standard deviations are computed using monthly observations over the 10-year period from 1998 through 2008.

IR derivatives. We measure the market value (cash flow) sensitivity of IR derivatives to IR movements as the estimated change in IR derivatives' value (annual cash flow) for a 191-percentage point change in the six-month yield on T-bills. The choice of 191 percentage points reflects a three-standard-deviation change in the annualized percentage point change in the six-month T-bill yield, using monthly observations over the 10-year period from 1998 through 2007.

COMM derivatives. The cash flow sensitivity of COMM derivatives to COMM price movements is measured as the estimated change in COMM derivatives' annual cash flows for a 37% change in the underlying COMM price. The choice of 78% reflects a three-standard-deviation change in the annualized percentage return on the quarterly Producer Price Index (PPI) for fuel over the 10-year period from January 1988 through December 1997.

APPENDIX B: Calculating delta and vega using the Black–Scholes option pricing model

In this appendix, we first present how CEO stock option values, deltas, and vegas are derived

The Black–Scholes (1973) model for valuing European call options modified for dividend payments, as Merton (1973), is as follows:

Value = S exp (-d*T)*N (d_1) - X exp (-r*T)*N (d_2) (B1)

where

$d_1 = (\ln\left(\frac{S}{X}\right) + T(r - d + \frac{\sigma^2}{2}))/\sigma\sqrt{T}$

$d_2 = d_1 - \sigma\sqrt{T}$

N (.) = cumulative probability function for the normal distribution S = share price of stock at the fiscal year-end d = dividend yield as of the fiscal year-end X = exercise price of the option

r = risk-free rate of US T-bond yields corresponding to the option's time to maturity d = annualized standard deviation of daily stock returns measured over the 120 days prior to the fiscal year-end

T = remaining years to maturity of the option

As Core and Guay (2002), the delta and vega measures are the option values' sensitivity with respect to a 1% change in stock price and a 0.01 change in the standard deviation, respectively, and are expressed as follows:

$$\frac{\partial value}{\partial S} * \frac{S}{100} = \exp\{-dT\}N(d1) * \frac{S}{100} \qquad \text{(B2)}$$

$$\frac{\partial value}{\partial S} * 0.01 = 0.01 * [\exp\{-d * T\}N'(d2)S\sqrt{T}] \qquad \text{(B3)}$$

where N' (.) is the normal probability density function.

The exact values of the exercise price and time to maturity are obtained from proxy statements for current-year option grants. For options granted in prior years, the CoreGuay (2002) algorithm is used. We estimate average exercise prices by subtracting the ratio of the realizable value of options to the number of options (for both exercisable and unexercisable options) from the fiscal year-end stock prices. The time to maturity is set at one year less the time to maturity of the current year's grant (or nine years if no new grant is made) for unexercisable options. The time to maturity is set at three years less the time to maturity of exercisable options (or six years if no new grant is made). The delta and vega values for shares of stock held are assumed to be equal to one and zero, respectively.

APPENDIX C: Firm variables

This appendix presents the company variables.

- Debt/Assets: Total debt to total book value of assets
- Deriv/Assets: Total derivatives value (*FX, IR,* and *COMM*) divided by total assets
- IR/Assets: Total notional value of interest rate (*IR*) derivatives scaled by total assets
- FX/Assets: Total notional value of foreign exchange (*FX*) derivatives scaled by total assets
- COMM/Assets: Total notional value of commodity (*COMM*) derivatives scaled by total assets
- Excess_Deriv Residual derivatives after controlling for endogeneity (using the method of Shen and Zhang, 2013) divided by total assets
- Foreign sales: International sales revenue divided by total sales revenue
- Capex/Assets: Logarithm of the total capital expenditure of the firm divided by the total book value of assets
- Quick ratio: (Current assets - inventories)/current liabilities
- R&D/Assets: Total R&D expenses of the firm divided by assets
- Insider own: CEO's insider stock ownership (%) of company shares
- Div Yield: Total dividend yield of the company, calculated by dividing dividends by the current stock price
- Lag FCF: Lagged free cash flow of the firm divided by assets
- Assets: Total book value of assets
- NOLs/Assets: Net operating loss carryforwards scaled by total assets

APPENDIX D: CEO risk preference variables

- Delta: Total delta of the CEO compensation portfolio (sum of the delta values of the CEO's current options, exercisable options, and un-exercisable options and of the CEO's stock options)
- Vega: Total vega of the CEO compensation portfolio (sum of the vega of the CEO's current options, exercisable options, and un-exercisable options)
- InDebt: The inside debt is the sum of the CEO's deferred compensation and pension benefits
- Cash: The sum of total salary and bonuses of the CEO's compensation portfolio
- Shares: CEO's total stock equity compensation
- High vega: A continuous variable that equals all vega values greater than the median CEO total vega
- High delta: A continuous variable that equals all delta values greater than the median CEO total delta

- High Shares: A continuous variable that uses all shares values greater than the median CEO total share compensation
- High InDebt: A continuous variable that uses all inside debt values greater than the median CEO total inside debt compensation
- High Cash: A continuous variable that uses all cash compensation values greater than the median CEO total cash compensation

CHAPTER 3

MANAGERIAL ABILITY AND HEDGING: A MULTIYEAR ANALYSIS

ABSTRACT

Using a multi-year derivatives-hedging data set we investigate whether high-ability managers are more likely to engage in more hedging than low-ability managers to protect their reputation capital in a competitive executive labor market, as predicted by the theory of managerial responses to asymmetric information. We find that high-ability managers do not engage in greater hedging than their low-ability counterparts. Specifically, the evidence shows that high-ability managers significantly increase firm value, but they do not undertake more hedging than low-ability managers who fail to increase firm value. These results reveal that high-ability managers do not use hedging as an indirect medium to communicate their abilities to market participants. They reveal their reputation through value increasing strategies than through hedging implying that they view hedging as an insurance policy against exogenous uncertainties.

INTRODUCTION

In recent times, volatility of currencies, interest rates and commodity prices has motivated corporate managers to undertake hedging on an unprecedented scale. The awareness of hedging as a risk management tool has increased over time as a result of financial disasters such as the US savings and loan disaster of the 1980s and the Asian currency crisis in 1997-98 that swept like a bush fire through the south East Asian countries of Thailand, Malaysia, Singapore, Indonesia, Hong Kong, and South Korea. Stock markets in many of these countries lost over 70% of their value and their currencies depreciated against the US dollar by a similar amount. While the attention of hedging at the corporate level has increased over the years the academic research on the important question why and when firms should hedge remains surprisingly unresolved.

The full information capital markets model of the firm does not say much about why firms hedge implying that whether firms hedge or not is irrelevant since investors can undertake the necessary hedging activities by themselves (Culp and Miller (1995)). Actually, the full information perfect capital markets model, holds the view that most value maximizing firms do not, in fact, hedge. The option pricing model, however, implies that firms will most likely pursue risky activities if they are run by equity holders as the option value of equity rises by the variance of such activities. In sum, corporate finance does not offer an explanation on why firms hedge and appears to imply that there are strong incentives against hedging.

In this study, in contrast of the prediction of the full information capital markets model, we examine whether hedging could be motivated by the theory of managerial responses to asymmetric information, which postulates that managers with superior abilities with respect to certain exogenous risks or uncertainties, will engage in hedging to ensure that their superior abilities (human capital) are quickly recognized by economic agents. The insight behind this view is that skilled corporate managers, mainly concerned about their managerial reputation in the competitive executive labor market where compensation is related to equity performance, have more incentives than low-ability managers to signal the true value of their human capital (managerial types) through increased hedging to help investors update their assessment about the quality of their managerial ability. That is, skilled CEOs with valuable reputations will choose to intentionally engage in more hedging to protect their reputation capital by conveying to the market that their companies are more effectively managed. At a conceptional level, according to the theory of managerial responses to asymmetric information, hedging could benefit the firm by improving the quality of information for outsider users, for example, by bringing their expectations closer to the ones held by the managers. Despite the increasing evidence that high-quality managers affect firm decisions and outcomes through more effectively implementing their chosen strategies than lower ability managers (Bertrand and Schoar, 2003; Demerjian, Lev, and McVay, 2012; Holcomb, Holmes, & Connelly, 2009)), to-date remains unknown whether and how managers' skills influence hedging. Accordingly, a high (low) ability CEO knows that his performance is likely to be better (worse) and as a result the probability of bankruptcy or forced turnover (dismissal risk) much lower (higher), making his equity option less (more) valuable at the margin which increases (decreases) the incentive of the higher (lower) ability CEO to hedge more (less). Alternatively, if high-ability managers significantly increase firm value through efficient operating and resource allocation strategies, as has been shown in previous studies, the need to resort to greater hedging to safeguard their reputation capital from asymmetric information is likely to be low. To put it differently, if uncertainty about a CEO's ability is low, hedging is not expected to be actively used to improve market participants' assessment of CEO ability. If this view gains support in the data, it would imply that hedging by high-ability CEOs is more likely to be undertaken as an insurance policy against exogenous uncertainties.

To address the above described predictions, we examine the relation between corporate hedging and the general CEO ability (i.e., managerial talent and skills that are transferable across industries and firms) which according to the seminal work of Becker (1962) stands for human capital that is not common to the firm.[12] Managerial skill is an intangible that identifies each firm and differentiates an Apple from a Microsoft. While traditional models disregard managerial heterogeneity in corporate decision-making assuming that their actions are homogenous (Berk and

[12] Becker (1962) in his seminal paper has emphasized on two types of human capital; one which is common to the firm and one which reflects the general ability of the CEO.

Stanton, 2007; Bamber et al., 2010), more recent studies have stressed the importance of CEO intangible attributes that CEO skills bring to the firm (Kaplan et al. 2012; Graham et al. 2012) and argue that CEO ability can provide firms with a competitive advantage over other firms (Camerer, 2003; Camerer, et al. 2004; Costa-Gomez and Crawford, 2006). Thus, a growing strand of the literature looks at the effect of managerial ability on corporate decisions such as investments (Bertrand and Schoar, 2003), stock return variabilty (Pan, Wang, and Weisbach, 2014), and accounting choices (Bamber et al. 2010) among others. Other studies show that managerial skill helps to lower firms' audit fees (Krishnan and Wang (2014)) and US banks managed by CEOs with superior skills have better forecasting of loan losses (Beatty and Liao (2011)). In this paper, we analyze if CEO managerial ability, through the MA score index devised by_Demerjian et al. (2012) influences corporate hedging decisions as the theory of managerial responses to asymmetric information predicts. To mitigate the likelihood that the MA score proxy may suffer from measurement error, we repeat the analysis employing our general ability index (GA index) as an alternative proxy of managerial skill, based on CEO past education and work experience as in Custodio et al. (2013), Our main two managerial ability measures can best be described as proxies of CEOs' general operational efficiency emerging from their human capital.[13]

This study contributes to the previous literature in the following ways. First, we investigate the effect of managerial ability on corporate hedging through total and individual derivatives (foreign exchange (FX), interest rate (IR), and commodity (COMM)) usage and relying on an unconditional testing environment. Second, unlike previous research, we investigate the use of derivatives conditional on the ability of CEOs inferred from the two managerial skill measures. Intuitively, we want to determine if variation in CEO ability affects hedging. To the

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13 We recognize that managerial ability is a concept with multiple qualities, such as operations, strategy, marketing, finance, and risk management.

best of our knowledge, no previous study has examined whether the undertaking of corporate hedging activities is related to managerial ability. Third, in contrast to previous studies that have relied on one-year derivatives data, we use a multiyear data set. Fourth, we analyze the hedging intensity of high and low managerial ability CEOs to determine whether their hedging decisions vary with managerial skill. This relation also has not been addressed in the previous literature. While Guay and Kothari (2003), in general, have examined the market value sensitivity of hedging to assess if hedging matters, their analysis is not conditioned on CEO ability. Fifth, we construct a new managerial ability index (GA index) using principal component analysis based on the previous education and work experience of CEOs. This measure builds on and extends the managerial index of Custodio et al. (2013) and appears to be more robust for several reasons. First, the Custodio et al. (2013) index pays no attention to the past education experience of CEOs. Since CEO past education is of paramount importance in building general managerial skills, ignoring that information might underestimate the strength of managerial skill. Second, they do not account for CEO tenure while Rajgopal et al. (2006) and Baik et al. (2011) find CEO tenure as a general managerial ability measure to determine firm level decisions. Our CEO managerial ability measure uses five aspects of a CEO's past professional and education experience: 1) if CEO received his MBA from an Ivy league school, 2) if CEO received his undergraduate degree from an Ivy league school, 3) if CEO is also the chairman of the board, 4) CEO tenure and 5) if the CEO has past experience in a technical/financial firm. The CEO GA index is the first factor of the principal component analysis of the five measures described above. Finally, we look at the effect of managerial ability on firm performance proxied by Tobin's q. While previous studies have analyzed this relation, the results have also been mixed. For example, Demerjian et al. (2012, 2013), Leverty and Grace (2012) and Chemmanur et al. (2009) find a positive relation between managerial ability and firm performance while Mishra (2014) and Culver et al. (2001) report a negative association between CEO skills and firm value. The more important reason for investigating the value-added ability of high-skill CEOs is to shed light on whether their exceptional managerial attributes, contrary to the prediction of theory of managerial responses to asymmetric information, ease off the need to engage in more hedging with the aim to reduce asymmetric information and consequently protect their managerial reputation capital.

Using a sample of Fortune 500 firms and panel fixed effect regression from 2008 to 2012, we find superior CEO managerial ability, based on the MA index of Demerjian et al. (2012), does not affect corporate hedging decisions. That is, CEOs with superior managerial skill do not undertake more hedging activities than their low skill counterparts through total firm derivatives usage or individual derivatives (FX, IR or COMM). This result is inconsistent with the theory of managerial responses to asymmetric information which posits that CEOs with superior management skills engage in greater hedging than low skill CEOs to ensure that their superior managerial abilities (value of human capital) are quickly revealed to and recognized by investors in the presence of noise. To put it differently, our results indicate that high-ability CEOs do not have strong incentives to hedge corporate risks associated with the uncertainty of interest rates, currency rates and commodity prices that are not under their control to protect the reputation of their human capital out of career concerns. Hedging by high-skill CEOs is not used to reduce potential market noise associated with their superior managerial skills. Additionally, we find that hedging intensity of high and low ability CEOs, using both managerial ability measures, are similar supporting our main result that CEO ability does not affect corporate hedging through derivatives use. Looking at the relation between managerial ability and firm value, we find that firms managed by high managerial ability CEOs are associated with greater firm value compared to firms managed by low-skill CEOs. Jointly, the superior firm value outcomes attained by skilled CEOs imply that they do not view corporate hedging as a mechanism to safeguard the value of their human capital (career concerns) due to information asymmetry. It seems that firms led by CEOs with superior managerial talents are not subject to information asymmetries necessitating the increase in hedging activities than firms under the helm of CEOs with lower skills. The documented similarity of hedging intensity by high- and low-skill CEOs in this study suggests that corporate hedging, regardless of their managerial skill differences, is viewed more as an insurance policy by high-skill CEOs than conveying their attributes of managerial skill to the marker to reduce information asymmetries. Our results are robust and hold when we use the GA index as an alternative managerial ability measure.

The remainder of the paper is organized as follows. Section 2 provides a brief description of the literature and hypothesis development. Section 3 describes the sample and methodology. Section 4 presents the results. Section 5 concludes the paper.

LITERATURE REVIEW AND HYPOTHESIS DEVELOPMENT

Managerial ability and corporate decisions

Previous studies have shown that managerial characteristics are important for various corporate decisions (Bertrand and Schoar, 2003; Graham et al. 2012; Kaplan et al. 2012). Hambrick and Mason (1984) and Hambrick (2007) proposed the upper echelons theory which stresses the importance of CEO skills due to the complex nature of firm decision-making processes. Malmendier and Tate (2005, 2008) find that CEOs that overestimate their abilities (overconfident) make value destroying M&As. The literature on organization (human) capital (Lev and Radhakrishnan, 2005; Eisfeldt and Papanikolaou, 2013) states that this intangible asset that defines a firm is an important valuable firm resource that potentially increases its value.

Building upon these theories, various measures of managerial ability have been used in the past (i.e., CEO tenure and media mentions (Milbourn, 2003), CEO overconfidence (Malmendier and Tate, 2005), CEO tenure (Rajgopal et al. 2006; Baik et al. 2011) among others). Due to the noise associated with using the above stated measures (Francis, 2008), in this paper we are using the MA Score index developed by Demerjian et al., (2012). Additionally, we construct a measure of managerial ability based on CEO past education and work experience (i.e., the CEO GA index) as mentioned earlier. This measure is an improved metric compared to the one used by Custodio et al. (2013) in that it does not omit CEO past education experience and CEO tenure, two aspects of CEO background characteristics which are critical in making the index. To put it differently, in this paper we examine whether high ability managers are more likely to hedge in accord with the theory of managerial responses to asymmetric information which predicts that they will engage in greater hedging to make sure that their superior abilities (human capital) are quickly conveyed to the market. The insight behind this view is that skilled CEOs engage in more hedging because they are mainly concerned about their careers and managerial reputation in the competitive executive labor market where compensation is related to equity performance. That is, they undertake more hedging to reduce the noise about their value-added managerial abilities in the presence of asymmetric. Hence, it is predicted that high (low) ability CEOs know that their performance will be better (worse) and as a result the probability of bankruptcy much lower (higher). Therefore, the value of their equity options become less (more) valuable at the margin which increases (decreases) the incentive of the higher (lower) ability CEO to hedge more (less). That is, the theory of managerial responses to asymmetric information predicts that CEOs with higher (lower) managerial ability will undertake more (less) hedging through derivatives (i.e., less risk than their low skill counterparts).

Managerial ability and firm value

CEOs with good management skills are more likely to perform better and hence maximize shareholder value (Schwartz and Menon, 1985; Donatiello, Larcker, and Tayan, 2018). Prior literature has long recognized (Bertrand and Schoar (2003), Choi et al. (2015), and Dejong and Ling (2013)) the importance of managerial ability for firm's investment, operational and financing, and other strategic decisions. That is, their individual characteristics, differences in their abilities and management styles are believed to be embedded in the value of the firms they run. In line with these studies, Lieberman et al. (1990) and Chang et al. (2010) among others find that CEO ability affects firm value and performance. However, previous studies on managerial ability and its effect on firm value have produced mixed results. Demerjian et al. (2012) report a positive relation between firm value and managerial ability using ROA and stock return as proxies for firm performance. Similarly, Finkelstein et al. (2009) find higher managerial ability to be associated with better firm performance. Likewise, Leverty and Grace (2009) report a positive and statistically significant relationship between firm performance and managerial ability. Specifically, they find that more able CEOs run firms more effectively, allocate resources efficiently, reduce costs and maximize revenues. Moreover, Cheung et al. (2017) using S&P firms show a positive relation between CEO ability and firm performance but the relation is moderated by the presence of managerial discretion and monitoring quality. Other studies, however, document a negative relation between managerial ability and firm value. For example, Mishra (2014) show that high ability managers are associated with more agency problems and thus engage in value destroying activities. Also, Culver et al. (2001) and Halek and Eisenhauer (2001) find higher ability CEOs to reduce firm value due to their risk averseness causing them to pass value enhancing projects. The mixed evidence on the relation between managerial ability and firm value offers an additional motivation to shed new light on whether CEOs with high (low) managerial ability run firms more (less) efficiently resulting in higher (lower) firm value. More importantly, in the context of this study we are more interested to find out whether the positive relation between managerial skill and firm value, which is more likely to reduce asymmetric information, has a countervailing effect on hedging. That is, if high-ability managers increase firm value through efficient operating and resource allocation strategies asymmetric the need to engage in more hedging to safeguard their reputation capital from asymmetric information is expected to be low. Hence, to the extent that asymmetric information is reduced through the valued-added ability of skilled CEOs, low hedging is more likely to be assumed by high-ability CEOs as an insurance policy against exogenous uncertainties.

SAMPLE SELECTION AND METHODOLOGY

Hedging (Derivatives) Data Collection

Data for the analysis are obtained for firms from the Fortune 500 list. The choice of Fortune 500 firms is mainly dictated for two reasons. First, most of the Fortune 500 companies are big and are more likely to use derivatives, compared to smaller firms as usage of derivatives is costly (Bodnar et al. 1998). Second, the Fortune 500 list encompasses companies from a wide array of industries, and so that would negate any industry bias. The initial sample consists of 500 companies out of which commercial banks, diversified financials, securities and insurance companies are omitted as their purpose of using derivatives is completely different (mainly speculation) from that of non-financial firms (mainly hedging risk). This reduces the sample size to 434 companies. The gross notional derivative information is obtained from the Mergent online database which is used to pull out 10K's of all the 434 companies for 5 years, i.e. , from 2008 to 2012 for a total of 2170 firm-year observations. To search for derivatives, we used the terms "hedge", "notional", "swaps", "foreign currency", and "forwards". We use the notional amount of derivatives from the 10ks to identify the corporate use of derivatives. Some of the previous studies have used the fair value of derivatives as the dependent variable in their analyses, but using fair value has many problems. First, the total notional amount of derivatives is the aggregate number that firms use for hedging which correctly depicts CEOs' hedging motive and currently denotes the total price the hedge has been established. Since the market value (fair value) of derivatives changes with the economy, it is not a reliable source for evaluating firm's total financial hedging. Second, very few firms report fair value in their 10ks and so using fair value would result in loss of many observations. On the other hand, all firms reveal their total notional amount of derivatives in their 10ks. Thus, firms which do not report the notional value of their derivatives in their 10ks (only fair values mentioned) are removed. In addition, private companies are excluded because they do not have public accounting data. Consistent with Geczy et al. (1997), firms involved in mergers and acquisitions (M&A) in the course of 5 years, are also removed from our sample. This sample screening yields a sample of 350 firms with 1630 total firm-year observations. In 10ks, firms report separately derivatives which are used for hedging and which are used for trading or speculation. We only include companies that use derivatives for hedging purposes and not for trading or speculation. Also, for some companies using commodities, the10Ks had the notional amount of commodity hedged. For example, firm A had hedged 10mmBtu of natural gas and 45 million barrels of crude oil. In that case to find the derivatives amount, we multiply the total amount by the underlying price of the asset at that time. In addition, some companies reported the total number of contracts in their 10Ks. To obtain the notional amount we multiply the number of contracts by the total contract unit from the CME website and the underlying price at that time. In case of foreign currency forwards or futures, all values are converted to the dollar values using the exchange rate at that time of the initiation of the contract.

Firm, managerial compensation and CEO ability data

The Thomson Reuters' database and Google finance are used as the main sources to obtain firm financial data. CEO managerial compensation information is obtained from the ExecuComp database and proxy statements. Out of 350 companies, 10 companies did not have appropriate exercised and non-exercised options data in the ExecuComp database reducing the sample to 340 firms and a total of 1446 firm-year observations. The 332 firms of this study have made use of derivatives for commodity price fluctuations (commodity futures and swaps), interest rate risk (interest rate swaps and locks) and foreign currency risk (FX forwards and futures). The MA Score index data are obtained from Demerjian et al. (2012).[14] CEOs' education and experience data for the construction of our GA index are obtained from firms' 10ks, proxy statements and the website www.nndb.com.

METHODOLOGY

Fixed effect regression analysis is used to regress the log of the derivatives divided by the assets of the firm on the MA Score index from Demerjian et al. (2012) controlling for CEO compensation and firm characteristics. Using fixed effect regressions helps us to remove managerial fixed effects and thus the managerial ability can be effectively measured using the MA Score index and the GA index.

Construction of the General Ability Index (GA Index)

To construct the General Ability managerial ability index, we use the principal component analysis method as in Custodio et al. (2013). In this study, the GA Index is constructed using the following five aspects of a CEO's past education and work experiences:

1. *CEO Ivy School MBA dummy (X1)*: Dummy variable that is equal to 1 if the CEO has an MBA from an Ivy League School, 0 otherwise. A CEO who has an MBA from an Ivy League School has better education and experience, and thus has more general skills to tackle firm investment decisions.
2. *CEO Ivy League School undergraduate dummy (X2):* Dummy variable that is equal to 1 if the CEO has undergraduate education from an Ivy League school, 0 otherwise. A CEO who has undergraduate education from an Ivy League School has better technical skills to handle corporate level decisions such as hedging.
3. *CEO tenure (X3):* Number of years, the CEO is in the current firm. The longer the CEO tenure, the more likely the CEO to possess better managerial ability and generic skills to deal with various organizational issues.
4. *CEO/chairman dummy (X4):* Dummy variable which is equal to 1 if the CEO is also the chairman of the board, 0 otherwise. A CEO, who is also the chairman, has probably more general human capital as chairman of the board has more responsibilities, duties to the shareholders and stakeholders.
5. *CEO finance and technical career experience dummy (X5):* Dummy variable equal to 1 if the CEO has finance and technical experience, 0 otherwise. CEOs who have worked in a finance and technical firm has acquired more technical, financial and generic skills to handle risk management activities compared to CEOs who do not have that experience.

We extract common components from all these five measures using Principal Component Analysis (PCA) and join them together into one index of General Managerial Ability Index (GA

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[14] MA Score data are available at http://faculty.washington.edu/pdemerj/data.html

Index). Using this single index rather than using five measures separately, we avoid the problem of multi-collinearity and spurious regression estimates.

VARAIBLES DESCRIPTION:

Dependent variables:

The main dependent variables of this study is the log of total notional value of derivatives scaled by assets which is used as our hedging measure and log of Tobin's q which is defined as the ratio of total assets minus the book value of shareholder equity plus the market value of equity to the book value of assets (Rossi and Laham, 2008; Bartram et al., 2011). Total derivatives consist of interest rate derivatives, foreign exchange derivatives and commodity derivatives. The derivatives data for are hand collected from firm's 10Ks and Mergent Online Database.

Independent variables:

Proxies for Managerial Ability:

We use two proxies for measuring managerial ability (MA) of CEOs, our main independent variable. First, is the managerial ability (MA) Score index from Demerjian et al. (2012). The authors used a two-step procedure where in the first step, they used DEA to generate a firm-level efficiency measure. In the second step, firm specific characteristics are removed giving us the CEO managerial ability as an error term. Appendix C provides a detailed explanation of the procedure. The second measure is the general ability CEO index variable (GA index). The GA index is constructed using principal component analysis by combining five aspects of CEO past education and experiences which might increase or decrease his general human capital. A higher value of the MA score and GA Index would imply that a CEO has greater managerial ability compared to his peers. We also divide both CEO MA score and GA index measures by their median for robustness tests. Index scores greater than the median are termed as high ability CEOs while scores lower than the median are termed as low ability CEOs.

Other Control Variables:

Previous literature has documented CEO option compensation sensitivities to be important predictors of corporate hedging. Therefore, in accord with the previous studies, we account for such sensitivities through the Delta and Vega of CEO option compensation. A CEO's option Delta is defined as the sensitivity of a CEO's option portfolio with respect to the stock price of the underlying security, also known as the "hedge ratio". This measure has been used extensively in the previous literature as a proxy for CEO risk aversion (Knopf et al. 2002, Rogers, 2002, Coles et al. 2006 among others). In the context of this study, the total Delta of a CEO's compensation portfolio (*Total CEO Delta*) is defined as the sum of the Delta due to the option portfolio and the stock portfolio. We expect a positive relation between the CEO's total Delta and hedging since the payoff of the CEO option is directly related to the firm's stock price which is designed to encourage risk aversion. CEO's option Vega is defined as the sensitivity of a CEO's option portfolio with respect to the volatility of the stock price. This variable is used in the previous literature as a proxy for CEO high risk tolerance (Knopf et al. 2002, Beber and Fabbri, 2012). The CEO's stock Vega is not significant as volatility of stock is close to zero (Guay, 1999). Thus, the total Vega of the CEO option portfolio (Total *CEO Vega*) is only due to the volatility of the option portfolio. Hence, we expect a negative relation between Vega and derivative hedging due to the convex payoff of the option-like contracts. Appendix A and B provide a detailed calculation of the total CEO Delta and total Vega. The CEO stock compensation variable captures the total CEO stock holdings (*CEO Share Equity*) in the firm. CEOs' with high stockholdings in the firm they run, are more likely to exhibit low risk tolerance, since a large fraction of their personal wealth would be invested in the firm (Stulz, 1984), and as a result engage in more hedging. Sundaram and Yermack (2007) and Edmans and Liu (2010) suggest that CEOs with higher inside debt (*CEO Inside debt*) are more likely to exhibit low risk tolerance since a large component of their wealth is tied to company stock performance and job security. Consequently, if inside debt (CEO pension and deferred compensation) deters CEO risk taking, we expect to observe a positive relation between hedging and CEO inside debt. All CEO compensation variables are obtained from ExecuComp database.

In accord with Smith and Stulz (1985) we also control for the reduction of expected taxes (using NOL carryforwards/Assets), reduction in financial distress (using Debt/assets ratio and interest coverage ratio/Assets) and the under-investment problem (using R&D/Assets and Capex/Assets) and expect a positive relation between all these variables and hedging (Graham and Smith, 1999; Graham and Rogers, 2002; Nance et al. 1993; Geczy et al. 1997; Froot et al. 1993; Knopf et al. 2002). To control for firm's idiosyncratic risk, we use the standard deviation of excess returns, using daily excess returns data from Crisp/Compustat database (Shen and Zhang, 2013; Rogers, 2002). We expect a negative relation between idiosyncratic risk and hedging activities.

To control for alternatives to hedging we use the dividend yield variable obtained from the Compustat database and expect a positive association between dividend yield (*Dividend yield*) and hedging (Nance et. al. 1993). To account for the multinational nature of firms, we use foreign sales to total sales (*Foreign/Total sales*). Hedging activities are anticipated to be positive associated with foreign sales correspond to higher foreign exchange risk (Fok et al. 1997 and Allayannis and Ofek, 2001). To control for firm size, we use the log of total assets as our control variable. The relationship between firm size and hedging could be positive or negative (Nance et. al., 1993; Warner, 1977; O'Brien & Bhushan, 1990). To control for agency problems in firms as noted by Jensen (1986), we include the insider ownership variable (*Insider own*). Firms that have higher information asymmetry between managers and shareholders tend to hedge more (Breeden and Vishwanathan (1998); DeMarzo & Duffie, 1991). Thus, firms with higher insider ownership (*Insider own*) should hedge due to lower information asymmetry and as a result we expect a negative link between insider ownership (Insider own) and derivative hedging. Quick ratio (*Quick ratio*) is a proxy for the liquidity of the firm. We expect a negative relation between quick ratio and hedging since firms which are more liquid have low hedging incentives and thus they are expected to make lower use of derivatives (Opler, 1999, Nance et. al., 1993).

RESULTS:

Managerial ability and derivative hedging

Table 1 describes the summary statistics of the variables used in the analysis. The MA Score (Demerjian et al. 2012) has a mean value close to 0 (0.034) which is expected as the residuals follow a normal distribution with a 0 mean. The General Ability Index has a mean of 2.24 with a standard deviation of 1.6 with a maximum value of 9.48. The high value of the GA ability index is expected due to the sample which consists of Fortune 500 large firms run mostly by highly educated and experienced CEOs. The total derivatives to assets is 0.10 suggesting that firms in our sample hedge only 10% of their total assets. The mean Tobin's q for our sample is 1.97 implying that an average firm in our sample is overvalued. The Delta and Vega of CEO option compensation are \$10.39 million and \$4.768 million, respectively, reflecting the large size of the firms in our sample. The Debt to assets ratio is 0.468 suggesting that firms in our sample have approximately 50% of debt in their books. The IR (Interest Rate) and FX (Foreign

Exchange) derivatives constitute 5% and 4% of the total assets, respectively, while the COMM (Commodity) derivatives represents only 0.8% of the total assets.

Table 1. Summary statistics

This table reports the descriptive statistics of the variables used in the analysis. Inside debt is the total pension and deferred compensation of CEO compensation. Total derivatives are addition of total notional values of interest rate, commodity and currency contracts. Idiosyncratic risk is the standard deviation of stock returns. Total observations are 1446. For detailed description of variables see Appendices C and D.

Variable	Mean	Std Dev	Min	Max
Inside Debt (millions)	8.878	0.1994	0	232.6
Idiosyncratic Risk	0.02	0.0122	0	0.114
Total Cash Compensation (millions)	1.494	0.022	0	0.31
Total Option comp value (Current, exercisable & un-exercisable options-in millions)	2.33	11.39	0	218
Delta of CEO Compensation (millions)	10.39	180.9	0	5275
Vega of CEO Compensation (millions)	4.768	123.3	0	4195
CEO Age (in years)	56.18	6.255	37	85
Tobin's Q	1.97	2.91	-4.43	32.66
CEO Stock Compensation (millions)	543.99	0.7444	0	1179
Debt to Assets ratio	0.468	1.15	0	25.38
Total sales (billions)	2.01	3.089	0	26.50
Total assets (billions)	2.691	5.860	0	79.78
R&D Expense-scaled by Assets	0.0144	0.0361	0	0.399
Capital Expenditures- scaled by Assets	0.0725	0.245	0	4.588
Total Derivatives- scaled by Assets	0.100	0.18	0	0.7
Interest rate derivatives- scaled by Assets	0.05	0.001	0	0.636
FX derivatives- scaled by Assets	0.04	0.08	0	0.67
Commodity derivatives- scaled by Assets	0.008	0.05	0	0.56
Managerial Ability (MA) Scores	0.034	0.17	-0.29	0.63
General Ability Index (GA Index)	2.24	1.6	0.123	9.48
Dividend Yield	0.0124	0.0182	0	0.146
Quick Ratio	0.946	0.819	0	7.568
Insider Ownership	0.0101	0.0627	0	1

Table 2 shows the results of the principal component analysis for the five proxies of general managerial ability index (GA Index) based on a CEO past education (MBA from top 10 Business school, undergraduate from top 10 B-school), CEO experience (CEO tenure and finance/technical career) and CEO dual role as chairman (Chairman/CEO)) characteristics. Using this methodology, we obtain only one component with an eigenvalue higher than one (eigenvalue of 1.34). As expected, all five CEO attributes have loadings which are positive, implying they are positively correlated with the GA index. This confirms our proxy to be robust and accurate as higher value of the general ability skills is manifested in a higher value of the index. The index gives close to equal weights to the CEO MBA education from an Ivy League school, CEO undergraduate education from an Ivy League School, and if the CEO is also the chairman of the board, and lower weights to CEO tenure and if CEO has technical and/or financial experience. The General Ability Index (GA Index) of CEO i in year t is calculated by applying the scores in Table 2 to the standardized general ability components:

$$GA_{I,\,t}\,(\text{General Ability Index}) = 0.2681\ X1_{i,\,t} + 0.2490\ X2_{i,\,t} + 0.1928\ X3_{i,\,t} + 0.1556\ X4_{i,\,t} + 0.1345\ X5_{i,\,t}$$

Table 2: General managerial ability index (GA Index): Principal component analysis

This table presents the results of applying principal components analysis to five proxies of general managerial ability based on a CEO past education (MBA from top 10 Business school, undergrad from top 10 B-school), CEO experience (CEO tenure and finance/technical career) and CEO dual role as chairman (Chairman/CEO). Factor loadings, scoring coefficients using the regression method, and eigenvalue and proportion of variation explained by the first factor are presented. The index is calculated by applying the scores to the standardized general ability components. Variable definitions are provided in Appendix E.

	MBA from top 10 B-School	**Undergraduate from top 10 B-School**	**Chairman/CEO**	**CEO Tenure**	**Finance/Technical career**
Loadings	0.624796	0.619801	0.281904	0.245017	0.293212
Scores	0.2681	0.2490	0.1928	0.1556	0.1345
Proportion Explained	0.2681				
Eigen Value	1.34				

Using fixed effect regressions and controlling for firm and managerial risk preferences,

Table 3 presents the effect of managerial ability, based on the MA Score Index variable (Demerjian et al. 2012), on corporate hedging through total and individual derivatives. Model 1 shows that the total derivatives hedging is unrelated to CEO managerial skill as the coefficient of the MA Score (*MAscores*) is not significant at any conventional level. The last three regressions show the impact of CEO managerial ability on hedging currency risk (Model 2) through FX derivatives, interest rate risk (Model 3) through IR derivatives and commodity price risk (Model 4) through COMM derivatives, respectively. The evidence, consistent with the total derivatives hedging results reveals that managerial ability has no effect on hedging FX, IR or COMM risk. Thus, the results in Table 3 suggest that corporate hedging decisions are not affected by CEO managerial ability implying that managers with superior abilities with respect to FX, IR or COMM risks or uncertainties they do not engage in hedging to ensure that their superior abilities (human capital) are quickly recognized by the market. That is, skilled corporate managers concerned about their managerial reputation in the competitive executive labor market do not appear to use corporate hedging to protect their managerial reputation by reducing information asymmetry as suggested by the theory of managerial responses to asymmetric information. Another interesting implication of these findings is that firms run by CEOs with superior management skills are not subject to considerable information asymmetries that would require them to undertake significant hedging to mitigate their effect on CEOs' skill reputation and career concerns. To put it differently, currency risk, interest rate risk and commodity price risk do not appear to make the equity options of skilled CEOs less valuable at the margin to increase their incentive to hedge more.

Table 3: The effect of managerial ability based on MA score on derivatives hedging

This table shows the fixed effect regressions of corporate hedging through total and individual derivatives on managerial ability based on the MA score values obtained from Demerjian et al. (2012) as the main independent variable. The dependent variable in Model 1 is Total derivatives (Total Deriv), in Model 2 is Foreign exchange derivatives (FX), in Model 3, is Interest rate derivatives (IR) and in Model 4 is Commodity derivatives (COMM). ***, **, and * indicate significance at the 1-percent, 5-percent, and 10-percent level, respectively. Standard errors are in parentheses. *** p<0.01, ** p<0.05, * p<0.1. Appendices D and E provide a detailed description of the variables.

VARIABLES	(1) **Total Deriv**	(2) **FX**	(3) **IR**	(4) **COMM**
MA Scores	***0.0772***	***0.338***	***-0.379***	***-0.121***
	(0.330)	***(0.364)***	***(0.382)***	***(0.376)***
Log (Cash comp)	0.0335	0.0163	0.0421	0.0713*
	(0.0326)	(0.0358)	(0.0376)	(0.0371)
Log (Delta)	-0.0148	-0.0764	-0.0338	-0.0671
	(0.0465)	(0.0512)	(0.0537)	(0.0529)
Log (Vega)	-0.00508	0.00224	-0.00995	-0.00896
	(0.00898)	(0.00988)	(0.0104)	(0.0102)
Log (Inside debt)	-0.0253	0.00917	-0.00796	0.0133
	(0.0190)	(0.0209)	(0.0219)	(0.0216)
Log (Shares)	0.00247	0.0704*	0.0316	0.0570
	(0.0332)	(0.0365)	(0.0383)	(0.0378)
NOLs/Assets	-0.178	-0.609	-0.00609	-0.286
	(0.821)	(0.904)	(0.949)	(0.935)
Debt/Assets	-0.0286	0.0240	-0.126	-0.0740
	(0.0762)	(0.0839)	(0.0881)	(0.0868)
MB ratio	0.000983	0.00228**	0.00168	0.000392
	(0.00103)	(0.00114)	(0.00119)	(0.00118)
Foreign/Total sales	0.848**	-0.209	1.000**	1.220***
	(0.412)	(0.453)	(0.475)	(0.469)
Log (Assets)	-0.494***	-0.355*	-0.653***	-0.135
	(0.176)	(0.194)	(0.204)	(0.201)
R&D/Assets	-0.556	-1.493	0.256	5.751
	(4.272)	(4.701)	(4.935)	(4.864)
Capex/Assets	-0.00575	-0.236	-0.0118	0.0296
	(0.328)	(0.361)	(0.379)	(0.374)
Idiosyncratic risk	-2.708	2.339	-0.817	1.638
	(4.187)	(4.607)	(4.837)	(4.768)
Quick ratio	0.200*	-0.127	0.0652	-0.0440
	(0.116)	(0.128)	(0.134)	(0.132)
Insider ownership	-0.0577	-0.0960	-0.550	-0.588
	(0.634)	(0.697)	(0.732)	(0.722)
Dividend yield	2.054	-3.275	-3.054	-11.37***
	(3.389)	(3.729)	(3.915)	(3.859)
Interest coverage ratio	-1.11e-05	0.000219	6.55e-05	0.000261
	(0.000223)	(0.000245)	(0.000257)	(0.000253)
Constant	9.312**	6.545	13.22***	1.193
	(4.166)	(4.585)	(4.813)	(4.744)
Observations	1,247	1,247	1,247	1,247
R-squared	0.022	0.022	0.027	0.036
Number of Company1	262	262	262	262

In Table 4, we report regression results using a binary MA score which equals 1 if the MA score is greater than the median which identifies high ability CEOs and 0 otherwise identifying low ability CEOs. These regression results are in line with the pattern that emerged in Table 3 suggesting that CEOs with high managerial ability do not significantly engage in greater hedging through total and individual derivatives. Interestingly, the coefficients of binary MA score is negative in all regression specifications.

Table 4: The effect of high managerial ability on derivative hedging

This table shows the fixed effect regressions of corporate hedging through total and individual derivatives on high managerial ability based on the binary MA Score variable obtained from Demerjian et al. (2012) as the main independent variable. MA scores greater than the median take the value of 1, and 0 otherwise. The dependent variable in Model 1 is Total derivatives (Total Deriv), in Model 2 is Foreign exchange derivatives (FX), in Model 3, is Interest rate derivatives (IR) and in Model 4 is Commodity derivatives (COMM). ***, **, and * indicate significance at the 1-percent, 5-percent, and 10-percent level, respectively. Standard errors are in parentheses. *** p<0.01, ** p<0.05, * p<0.1. Appendices D and E provide a detailed description of the variables.

VARIABLES	(1) Total Deriv	(2) FX	(3) IR	(4) COMM
Binary MA Scores	***0.0971***	***0.0181***	***0.00172***	***0.0196***
	(0.0931)	***(0.103)***	***(0.108)***	***(0.106)***
Log (Cash comp)	0.0336	0.0181	0.0400	0.0706*
	(0.0325)	(0.0358)	(0.0376)	(0.0370)
Log (Delta)	-0.0161	-0.0755	-0.0351	-0.0679
	(0.0465)	(0.0512)	(0.0537)	(0.0530)
Log (Vega)	-0.00497	0.00217	-0.00984	-0.00890
	(0.00897)	(0.00988)	(0.0104)	(0.0102)
Log (Inside debt)	-0.0260	0.00947	-0.00850	0.0129
	(0.0190)	(0.0209)	(0.0220)	(0.0216)
Log (Shares)	0.00334	0.0705*	0.0317	0.0572
	(0.0332)	(0.0365)	(0.0383)	(0.0378)
NOLs/Assets	-0.157	-0.601	-0.0106	-0.283
	(0.821)	(0.904)	(0.949)	(0.936)
Debt/Assets	-0.0260	0.0187	-0.120	-0.0711
	(0.0761)	(0.0838)	(0.0880)	(0.0867)
MB ratio	0.000991	0.00227**	0.00169	0.000397
	(0.00103)	(0.00114)	(0.00120)	(0.00118)
Foreign/Sales	0.854**	-0.208	1.000**	1.221***
	(0.411)	(0.453)	(0.476)	(0.469)
Log (Assets)	-0.491***	-0.356*	-0.652***	-0.135
	(0.176)	(0.194)	(0.204)	(0.201)
R&D/Assets	-0.548	-1.401	0.149	5.715
	(4.268)	(4.702)	(4.936)	(4.863)
Capex/Assets	-0.0186	-0.209	-0.0469	0.0145
	(0.327)	(0.360)	(0.378)	(0.373)
Idiosyncratic risk	-3.128	2.540	-1.153	1.435
	(4.201)	(4.627)	(4.858)	(4.786)
Quick ratio	0.199*	-0.126	0.0635	-0.0447
	(0.116)	(0.128)	(0.134)	(0.132)
Insider ownership	-0.0400	-0.0982	-0.543	-0.582
	(0.634)	(0.698)	(0.733)	(0.722)
Dividend Yield	2.035	-3.446	-2.857	-11.31***
	(3.383)	(3.726)	(3.912)	(3.854)
Interest coverage ratio	-1.26e-05	0.000222	6.21e-05	0.000259

	(0.000222)	(0.000245)	(0.000257)	(0.000253)
Constant	9.232**	6.510	13.24***	1.185
	(4.164)	(4.587)	(4.816)	(4.745)
Observations	1,247	1,247	1,247	1,247
R-squared	0.023	0.021	0.026	0.036
Number of Company1	262	262	262	262

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Next, we repeat the fixed effect regression analysis using the Top 25% MA score variable to quantify the relation between high managerial ability and hedging. To perform this test, we create a binary variable that takes the value of 1 when a CEO has a MA score in the top 25% (high managerial ability), and 0 otherwise. The results, reported in Table 5, indicate that even the CEOs with the highest managerial ability score do not engage in significant hedging activities.

Table 5: The effect of managerial ability based on the top 25% MA score on derivative hedging

This table shows fixed effect regressions of corporate hedging through total and individual derivatives on the top 25% quartile of MA Score (binary variable) obtained from Demerjian et al. (2012) as the main independent variable. MA scores in the first (top 25%) quartile take the value of 1, and 0 otherwise. The dependent variable in Model 1 is Total derivatives (Total Deriv), in Model 2 is Foreign exchange derivatives (FX), in Model 3, is Interest rate derivatives (IR) and in Model 4 is Commodity derivatives (COMM). ***, **, and * indicate significance at the 1-percent, 5-percent, and 10-percent level, respectively. Standard errors are in parentheses. *** p<0.01, ** p<0.05, * p<0.1. Appendices D and E provide a detailed description of the variables.

VARIABLES	(1) Total Deriv	(2) FX	(3) IR	(4) COMM
MA Score Top 25%	***-0.0361***	***0.0832***	***-0.163***	***0.0309***
	(0.113)	***(0.128)***	***(0.131)***	***(0.127)***
Log (Cash comp)	0.0327	0.0200	0.0332	0.0697*
	(0.0315)	(0.0358)	(0.0368)	(0.0356)
Log (Delta)	-0.0203	-0.0216	-0.0204	-0.0473
	(0.0375)	(0.0427)	(0.0438)	(0.0424)
Log (Vega)	-0.00606**	-0.000960	-0.00582*	-0.00689**
	(0.00299)	(0.00340)	(0.00348)	(0.00338)
Log (Inside debt)	-0.0260	0.00633	-0.00875	0.0119
	(0.0183)	(0.0209)	(0.0214)	(0.0207)
Log (Shares)	0.00924	0.0351	0.00216	0.0347
	(0.0275)	(0.0313)	(0.0321)	(0.0311)
NOLs/Assets	-0.282	-0.677	-0.164	-0.325
	(0.816)	(0.927)	(0.952)	(0.922)
Debt/Assets	-0.0587	0.00969	-0.153*	-0.0643
	(0.0737)	(0.0838)	(0.0860)	(0.0833)
MB ratio	0.000173	7.30e-05	0.000197	0.000228
	(0.000143)	(0.000163)	(0.000167)	(0.000162)

Foreign/Total sales	0.965**	-0.199	1.128**	1.101**
	(0.388)	(0.442)	(0.453)	(0.439)
Log (Assets)	-0.563***	-0.352*	-0.763***	-0.121
	(0.166)	(0.189)	(0.193)	(0.187)
R&D/Assets	-0.480	-1.332	0.862	5.623
	(4.254)	(4.837)	(4.963)	(4.809)
Capex/Assets	-0.0218	-0.170	-0.0690	0.000779
	(0.324)	(0.369)	(0.378)	(0.366)
Idiosyncratic risk	-5.111	4.768	-2.887	2.665
	(3.850)	(4.378)	(4.492)	(4.353)
Quick ratio	0.201*	-0.122	0.0806	-0.0853
	(0.111)	(0.126)	(0.130)	(0.126)
Insider ownership	-0.0382	-0.288	-0.466	-0.628
	(0.627)	(0.713)	(0.731)	(0.708)
Dividend yield	2.281	-2.733	-3.999	-13.56***
	(3.087)	(3.511)	(3.602)	(3.490)
Interest coverage ratio	-1.43e-05	0.000248	9.48e-05	0.000213
	(0.000216)	(0.000246)	(0.000252)	(0.000244)
Constant	10.96***	6.288	16.10***	1.006
	(3.940)	(4.480)	(4.596)	(4.454)
Observations	1,451	1,451	1,451	1,451
R-squared	0.027	0.013	0.029	0.039
Number of Company1	302	302	302	302

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

To check the robustness of our results, we replicate the previous analysis using our previously constructed GA index as a proxy of CEO managerial ability. Using this new managerial ability measure, as shown in Table 6, our results remain essentially the same. Specifically, as before, we find managerial ability not to influence firm's hedging decisions[15].

Table 6: The effect of managerial ability based on GA index on derivative hedging

This table shows fixed effect regressions of corporate hedging through total and individual derivatives on the General Ability (GA) index calculated as shown in Table 2 as the main independent variable. The dependent variable in Model 1 is Total derivatives (Total Deriv), in Model 2 is Foreign exchange derivatives (FX), in Model 3, is Interest rate derivatives (IR) and in Model 4 is Commodity derivatives (COMM). ***, **, and * indicate significance at the 1-percent, 5-percent, and 10-percent level, respectively. Standard errors are in parentheses. *** p<0.01, ** p<0.05, * p<0.1. Appendices D and E provide a detailed description of the variables.

VARIABLES	(1) Total Deriv	(2) FX	(3) IR	(4) COMM

[15] In unreported results, we also obtain similar findings with the ones reported in Tables 4 and 5 when we estimate the base line regressions using high CEOs ability measures gauged through GA index scores above median and in the top 25%.

Log (GA index)	***0.0540***	***-0.0118***	***0.227***	***0.00332***
	(0.0683)	***(0.0777)***	***(0.295)***	***(0.00404)***
Log (Cash Comp)	0.0318	0.0207	0.0258	7.43e-05
	(0.0315)	(0.0358)	(0.136)	(0.00186)
Log (Delta)	-0.0251	-0.0203	0.0261	0.000880
	(0.0380)	(0.0432)	(0.164)	(0.00225)
Log (Vega)	-0.00610**	-0.000950	-0.00548	-0.000841***
	(0.00299)	(0.00340)	(0.0129)	(0.000177)
Log (Inside debt)	-0.0272	0.00728	-0.00801	0.000350
	(0.0183)	(0.0209)	(0.0793)	(0.00109)
Log (Shares)	0.00850	0.0349	-0.0422	-0.000110
	(0.0275)	(0.0313)	(0.119)	(0.00163)
NOLs/Assets	-0.301	-0.658	-1.625	0.0251
	(0.815)	(0.927)	(3.522)	(0.0482)
R&D/Assets	-0.300	-1.333	12.07	0.154
	(4.260)	(4.846)	(18.40)	(0.252)
Capex/Assets	-0.0346	-0.155	-1.077	0.0160
	(0.324)	(0.368)	(1.398)	(0.0191)
Debt/Assets	-0.0606	0.00667	-3.596***	-0.0135***
	(0.0736)	(0.0838)	(0.318)	(0.00436)
MB ratio	0.000179	7.12e-05	0.000144	-2.37e-06
	(0.000143)	(0.000163)	(0.000619)	(8.47e-06)
Foreign/Total sales	0.952**	-0.189	0.381	-0.00378
	(0.388)	(0.442)	(1.678)	(0.0230)
Log (Assets)	-0.567***	-0.355*	-1.550**	0.0127
	(0.166)	(0.189)	(0.717)	(0.00981)
Idiosyncratic risk	-5.093	4.853	-1.724	-0.204
	(3.848)	(4.377)	(16.62)	(0.228)
Quick ratio	0.200*	-0.121	0.0631	0.00274
	(0.111)	(0.127)	(0.480)	(0.00658)
Insider ownership	-0.0389	-0.295	2.114	0.0173
	(0.626)	(0.713)	(2.706)	(0.0371)
Dividend yield	2.351	-2.808	-26.05*	-0.180
	(3.085)	(3.510)	(13.33)	(0.183)
Interest coverage ratio	-8.00e-06	0.000249	0.000117	-3.08e-07
	(0.000216)	(0.000246)	(0.000934)	(1.28e-05)
Constant	11.13***	6.325	38.06**	-0.287
	(3.946)	(4.489)	(17.04)	(0.233)
Observations	1,451	1,451	1,451	1,451
R-squared	0.028	0.013	0.122	0.044
Number of Company1	302	302	302	302

Collectively, the above results strongly suggest that managerial ability does not affect corporate hedging activity. More importantly, our evidence points out that CEOs with high managerial skill, regardless of which measure is used, do not engage in hedging currency risk, interest rate risk and commodity price risk, out of their control and skill capacity, to mitigate information asymmetries which, in turn, would help them avoid managerial reputation losses. Firms led by talented CEOs do not appear to face serious information asymmetries that would require significant use of derivatives hedging as predicted by the theory of managerial responses to asymmetric information. That is, skilled CEOs do not consider the use of derivatives as a first order policy to overcome information asymmetries.

Managerial ability and derivative hedging intensities

To gain a deeper insight on the hedging sensitivities of CEOs with varying managerial skills, we examine the hedging intensities of low and high skilled CEOs. CEOs with MA and GA scores greater (lower) than the median, defined as high (low) skill CEOs. As shown in Table 7, the average hedging intensities of high and low skilled CEOs are similar (0.1125 and 0.1130) suggesting that different CEO managerial abilities do not affect hedging. This result provides supplemental evidence against the prediction of the theory of managerial responses to asymmetric information which postulates greater hedging for firms led by CEOs with superior managerial skills and lower ability CEOs may or may not hedge. The documented similarity of hedging intensity between high and low skill CEOs coupled with our earlier findings suggest that skilled CEOs do not undertake more hedging to make sure that their superior managerial abilities are swiftly discovered by market participants in response to information asymmetries. That is, hedging is not used by skilled CEOs to reduce the noise that is likely to shadow the true value of their superior ability. In fact, the superior performance of firms run by skilled CEOs reduces the information asymmetry and uncertainty about their managerial ability which, in turn, allows market participants to draw more accurate assessment about the CEO ability from firms' profits than from hedging.

Table 7: Hedging intensity of CEOs with high and low managerial ability

This table reports the hedging intensity of firms managed by low and high managerial ability CEOs. Hedging intensity is measured based on the total derivatives to assets ratio. The managerial ability variables are then divided by their median values into high CEO ability if the MA score and GA score indices are greater than the median, and low ability CEOs if the MA and GA index scores are less than the median. Appendices D and E provide a detailed description of the variables.

Firm	High CEO Ability (high MA Score)	High CEO Ability (high GA Index score)	**Average of High CEO Ability**	Low CEO Ability (Low MA Score)	Low CEO Ability (Low GA Index Score)	**Average of Low CEO ability**	**Average for all CEOs**
Hedging Intensity	0.104	0.121	**0.1125**	0.121	0.105	**0.1130**	**0.110**

Managerial ability and firm value

Next, we analyze the valuation effects of managerial ability and expect to exert a positive and significant impact on firm value. Specifically, if firms run by skilled CEOs, are expected to do better than firms run by low skill CEOs, it would imply that the former will be subject to low information asymmetries which should not necessitate them to undertake more hedging to reduce the market noise blurring their superior managerial talent with fretting implications about the fate of their executive careers. That is, to the extent that skilled CEOs are capable to increase firm value should lower the need to hedge more to reduce information asymmetry and the effort of market participants to discover their superior managerial ability. This finding would be consistent with the documented evidence that has been reported so far.

The results in Table 8, show that CEOs with higher managerial ability, based on the MA score and GA index, have a positive and significant effect on firm value at the 1% level. Consistent with previous evidence (Demerjian et al. (2012, 2013)), our results suggest that firms managed by high skilled CEOs are associated with higher firm value compared to firms managed by low ability CEOs. This result is in line with our earlier conjecture that skilled CEOs with a positive and significant impact on firm value are more likely to undertake less hedging as shown in Tables 3-7. Hence, the ability of skilled CEOs to significantly raise firm value, which should lower the information asymmetries with equity holders, offers a reasonable explanation why they do not undertake more hedging. That is, skilled CEOs ability to add firm value reduces markets' effort to discover the true value of their managerial abilities that, in turn, alleviates their career concerns resulting in lower hedging.

Table 8: The effect of managerial ability on firm value

This table reports the pooled OLS regression of firm value measured by log of Tobin's q on CEO managerial ability, through the MA score and Log of GA Index. ***, **, and * indicate significance at the 1-percent, 5-percent, and 10-percent level, respectively. Standard errors are in parentheses. *** p<0.01, ** p<0.05, * p<0.1. Appendices D and E provide a detailed description of the variables.

VARIABLES	(1) Tobin q	(2) Tobin q
MA Scores	***0.436****	
	(0.124)	
Log (GA Index)		***0.0577****
		(0.0220)
Debt/Assets	0.116***	0.131***
	(0.0200)	(0.0198)
Foreign/total sales	0.363***	0.398***
	(0.0764)	(0.0734)
Log (Assets)	-0.0771***	-0.0790***
	(0.0200)	(0.0180)
R&D/Assets	-0.799	-0.0602
	(0.667)	(0.613)
Capex/Assets	-0.0144	-0.0268
	(0.0773)	(0.0780)
Quick ratio	0.0253	0.0187
	(0.0258)	(0.0248)
Insider ownership	-0.257	-0.217
	(0.265)	(0.265)
Dividend yield	4.507***	4.768***
	(1.132)	(1.073)
Interest coverage ratio	-2.35e-05	-2.49e-05
	(9.70e-05)	(9.76e-05)
Lagged FCF/asset	0.0892	0.124**
	(0.0544)	(0.0530)
Constant	1.568***	1.619***
	(0.607)	(0.539)
Observations	1,238	1,442
R-squared	0.422	0.390
Industry	Y	Y
Year	Y	Y

CONCLUSION

In this paper, we investigate whether managerial ability affects corporate hedging decisions. Using a multi-year derivatives-hedging data set and two managerial ability measures, we find no evidence that managerial ability is positively associated with corporate derivatives-hedging as the theory of managerial responses to asymmetric information predicts. Specifically, our evidence points out that skilled managers do not use hedging as an indirect medium to communicate their abilities to market participants. This result suggests that CEOs with superior skills do not hedge more than their low-skill counterparts to reduce information asymmetry (noise) about their managerial ability as this theory predicts. More important, consistent with previous evidence (Demerjian et al. 2012, 2013)) and other studies (Kaplan et al. (2012); Graham et al. (2012) and Xuan, (2009) stressing the importance of CEO general capital and skills that make firms more competitive compared to their peers, our findings show that high ability managers run firms more efficiently resulting in higher firm value compared to firms managed by low-skill CEOs. Jointly, the superior firm value creation ability attained by skilled CEOs implies that they do not view corporate hedging as a mechanism to safeguard the value of their human capital (career concerns) due to information asymmetry with investors. This explains why they do not engage in more hedging as the theory of managerial responses to asymmetric information postulates. That is, the superior value creation of high ability managers reduces the need to engage in more hedging in order to facilitate market participants' accurate assessment of CEOs' ability, which changes expected future cash flows. Finally, we find no hedging intensity differences between high- and low-ability CEOs. In fact, they are strikingly similar suggesting that hedging is viewed more as an insurance policy (Stulz, 2013) than as a decision to convey quickly and more accurately CEOs' attributes of managerial skill to the marker due to information asymmetries. Overall, our results suggest that value maximizing firms led by high ability CEOs do not, in fact, engage in more hedging.

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Appendix A: Calculation of total Vega and total Delta of option and stock portfolios

The Delta and Vega of the stock option portfolios are calculated using the Core and Guay (2002) approach. Core and Guay (2002) separately calculated the option grants for the current year and the previously granted options. For the current year option grants, we collect data for CEOs' number of options from the ExecuComp database. Exercise price and time of maturity variables for current year option grants are obtained from ExecuComp. Other variables which are required to estimate the Delta and Vega like stock price, volatility, interest rate and dividend yield are collected from the firm proxy statements and 10k reports. Consistent with the previous literature, the Black-Scholes option valuation formula is used to calculate the option price for the current-year options (Knopf et al. 2002; Rogers, 2002).

For the previously granted options, ExecuComp lists separately the number of exercisable and un-exercisable options in their database but it does not contain the exercise price and time of maturity variables for them. The Core and Guay (2002) approach is used to approximate the time of maturity and exercise price for both exercisable and un-exercisable options. We calculate the Delta and Vega of the exercisable and un-exercisable options separately. Time of maturity of the previously exercisable options, is approximated as the time of maturity of current options minus four, and for previously un-exercisable options, time of maturity minus one. We calculate the exercise prices by subtracting the total value of the option portfolio and the current year option portfolio value. Then, we divide this number by the number of options to get the difference of the stock and exercise price. Finally, we subtract this number with the stock price to get the exercise price. We calculate the exercise price separately for exercisable as well as un-exercisable options. Core and Guay (2002) have shown that this approximation is very close to actual values. Other variables which are required to estimate the Delta and Vega of previously granted options like stock price, volatility, interest rate and dividend yield are collected from the firm proxy statements and 10k reports. Appendix B provides the calculation of Delta and Vega using the Black-Scholes Options model.

We also calculate the Delta of the stock portfolio of the CEO. Thus, the total Delta of the option portfolio is the sum of the Delta of the current year option portfolio, plus Delta of previous year's exercisable and un-exercisable options and the sum of the Delta of the stock portfolio. Similar calculation procedure is employed to estimate the Vega of the current option grants, previous exercisable and un-exercisable options. Vega for the stock portfolio is assumed to be zero. Therefore, the total Vega is the sum of the Vega of the current year options, previous year's exercisable and previous year's un-exercisable options. Finally, we multiply the Vega and Delta with the total number of options to obtain the Vega (*CEO Total Vega*) and Delta (*CEO Total Delta*) of the entire CEO compensation portfolio. The above-mentioned procedure is used to calculate the Vega and Delta for each of the five years (2008-2012).

Appendix B: Calculating delta and Vega using the Black–Scholes option pricing model

In this appendix, we first present how CEO stock option values, deltas, and vegas are derived

The Black–Scholes (1973) model for valuing European call options modified for dividend payments, as Merton (1973), is as follows:

$$\text{Value} = S \exp(-d^*T)^*N(d_1) - X \exp(-r^*T)^*N(d_2) \qquad \text{(B1)}$$

where

$d_1 = (\ln\left(\frac{S}{X}\right) + T(r - d + \frac{\sigma^2}{2}))/\sigma\sqrt{T}$

$d_2 = d_1 - \sigma\sqrt{T}$

N (.) = cumulative probability function for the normal distribution

S = share price of stock at the fiscal year-end

d = dividend yield as of the fiscal year-end

X = exercise price of the option

r = risk-free rate of US T-bond yields corresponding to the option's time to maturity

d = annualized standard deviation of daily stock returns measured over the 120 days prior to the fiscal year-end

T = remaining years to maturity of the option

As Core and Guay (2002), the delta and vega measures are the option values' sensitivity with respect to a 1% change in stock price and a 0.01 change in the standard deviation, respectively, and are expressed as follows:

$$\frac{\partial value}{\partial S} * \frac{S}{100} = \exp\{-dT\}\, N(d1) * \frac{S}{100} \qquad \text{(B2)}$$

$$\frac{\partial value}{\partial s} * 0.01 = 0.01 * [\exp\{-d * T\}\, N'(d2) S\sqrt{T}] \qquad \text{(B3)}$$

where N' (.) is the normal probability density function.

The exact values of the exercise price and time to maturity are obtained from proxy statements for current-year option grants. For options granted in prior years, the CoreGuay (2002) algorithm is used. We estimate average exercise prices by subtracting the ratio of the realizable value of options to the number of options (for both exercisable and unexercisable options) from the fiscal year-end stock prices. The time to maturity is set at one year less the time to maturity of the current year's grant (or nine years if no new grant is made) for unexercisable options. The time to maturity is set at three years less the time to maturity of exercisable options (or six years if no new grant is made). The delta and vega values for shares of stock held are assumed to be equal to one and zero, respectively.

Appendix C: Calculating MA Scores

We follow the two-step methodology of Demerjian et al. (2012, 2013) in measuring managerial ability. The first step is to use data envelopment analysis (DEA) to create an initial measure of the relative efficiency of the firm within its industry (Charnes et al. 1978). DEA is a linear programming methodology that measures the relative efficiency of decision-making units (firms) by evaluating inputs (labor, capital, etc.) relative to outputs (revenue, income, etc.). Efficient firms are those that generate more revenues from a given set of inputs. The following optimization is applied to estimate firm efficiency:

$Max\ V\ \theta$ =Sales/ (v1CoGS + v2SG&A + v3PPE + v4OpsLease + v5R&D + v6Goodwill + v7OtherIntan)

where CoGS is cost of goods sold; SG&A is selling and administrative expenses; PPE is net PP&E; OpsLease is net operating leases; R&D is net research and development; Goodwill is purchased goodwill; and OtherIntan is other intangible assets. The firm efficiency measure, however, is affected by both firm-specific factors and management characteristics. The second step is to remove firm-specific characteristics from the DEA generated firm efficiency measure. This is done by removing the effects of firm size, market share, free cash flow, firm age, multi-segment and international operations challenges by performing the following regression:

Firm Efficiency i = α0 + α1 *ln* (*Total Assets*) *i* + α2 (*Market Share) i* + α3 (*Free Cash Flow Indicator) i* + α4 *ln* (*Firm Age*) *i* + α5 (*Business Segment Concentration) I* + α6 (*Foreign Currency Indicator) i* + α7 (*Year Indicator) i* + ε*i*

According to Demerjian et al. (2012), the error term of the regression measures managerial ability.

Appendix D: Firm variables

This appendix presents the company variables.

- Debt/Assets: Total debt to total book value of assets
- Deriv/Assets: Total derivatives value (*FX, IR,* and *COMM*) divided by total assets
- IR/Assets: Total notional value of interest rate (*IR*) derivatives scaled by total assets
- FX/Assets: Total notional value of foreign exchange (*FX*) derivatives scaled by total assets
- COMM/Assets: Total notional value of commodity (*COMM*) derivatives scaled by total assets
- Foreign sales: International sales revenue divided by total sales revenue
- Capex/Assets: Logarithm of the total capital expenditure of the firm divided by the total book value of assets
- Quick ratio: (Current assets - inventories)/current liabilities
- R&D/Assets: Total R&D expenses of the firm divided by assets
- Insider own: CEO's insider stock ownership (%) of company shares
- Div Yield: Total dividend yield of the company, calculated by dividing dividends by the current stock price
- Lag FCF: Lagged free cash flow of the firm divided by assets
- Assets: Total book value of assets
- NOLs/Assets: Net operating loss carryforwards scaled by total assets

Appendix E: CEO managerial ability and CEO compensation variables

- MAScores: Continuous MA Score index variable obtained from Demerjian et al. 2012.
- BinaryMAmedian: Binary Managerial ability variable. It takes value of 1 if score is greater than the median, 0 otherwise.

- MA1stquartile: Binary managerial ability variable. It takes value of 1 if score index value is in the first quartile, and 0 otherwise.
- GA Index: Managerial general ability index; obtained using PCA analysis based upon past CEO education and experiences.
- High CEO ability: If MA score index and GA score index greater than median value.
- Low CEO ability: If MA score index and GA score index lower than median value.
- Delta: Total delta of the CEO compensation portfolio (sum of the delta values of the CEO’s current options, exercisable options, and un-exercisable options and of the CEO’s stock options)
- Vega: Total vega of the CEO compensation portfolio (sum of the vega of the CEO’s current options, exercisable options, and un-exercisable options)
- Inside Debt: The inside debt is the sum of the CEO’s deferred compensation and pension benefits
- Cash: The sum of total salary and bonuses of the CEO’s compensation portfolio
- Shares: CEO’s total stock equity compensation

CONCLUSION

This dissertation participates into the study stream of derivatives use by non-financial firms by investigating the relation between CEO's risk preferences and managerial ability and its effect on derivative hedging and firm value. Not finding support for the effect of CEO risk preferences and the three theories of Smith and Stulz (1985) on hedging suggests that previous significant results could be due to chance as they used just 1 year or due to the fact they used only 1 kind of derivatives i.e. IR, FX or COMM. Also, finding the hedging intensities of risk seeking and risk averse CEOs to be similar suggests that CEO compensation contracts devised by the Board of Directors do not work, and risk seeking CEOs hedge to the same extent as the risk averse CEOs. Additionally, finding the value gains from using derivatives to be minimal suggests that hedging is used more as an insurance policy rather than a value maximization strategy by firms. Also, we did not find support for the theory of managerial response to asymmetric information while we found higher ability managers run their firms more efficiently resulting in higher firm value. This two results suggests that CEOs do not use hedging as a signal to show their reputation to the market, rather the high firm value shows the outside investors the reputation and high ability of CEOs. Given the important role of derivatives for managing the risk management program of non-financial firms, the findings of this dissertation i.e. low usage of the derivatives by these firms and the simultaneous minimal value gains from their usage suggests that managers should look at alternate ways like operational hedges, to hedge their risk.

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Publications

Doukas, J., and Mandal, S., (September, 2018) "CEO risk preferences and hedging decisions: A multiyear analysis". ***Journal of International Money and Finance*****, 86, 131-153.**

Theory and previous empirical studies suggest that CEO risk preferences affect hedging. We challenge this idea in a 5-year time series setting by using inside debt (i.e., CEO pension and deferred compensation) and the CEO Vega and CEO Delta, as proxies of CEO risk preferences, and document that neither risk-averse (i.e., debt like compensation) nor risk-seeking (i.e., convex compensation) inducing CEO compensation packages influence corporate hedging. Moreover, we find CEOs who have more previous work experience and high job tenure to be positively related to hedging.

Job Market Paper

"CEO risk preferences, hedging intensity and firm value", with Doukas, J., and Mandal, S.

Using a unique multi-year data set, this study examines the hedging intensity and market value sensitivity of firms run by CEOs with different risk preferences. Unlike previous studies, we find hedging intensities of risk-seeking and risk-averse CEOs to be strikingly similar. We also find, that when the average firm experiences an extreme (a three-standard deviations) change in interest rates, commodity prices and foreign exchange rates, its derivatives portfolio creates only modest gains regardless of CEOs' risk preferences. These findings are consistent with the view that hedging is just an insurance policy and not a firm value increasing strategy.

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